AD-A099 377   ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS   F/G 13/13
VALIDATION REPORT: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF --ETC(U)
FEB 81 W A PRICE, R L HALL, R L MOSHER

UNCLASSIFIED WES-INSTRUCTION-K-81-3 NL

1 OF 4
AD
A099377

INSTRUCTION REPORT K-81-3

VALIDATION REPORT: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS (TWDA)

by

William A. Price, Robert L. Hall, Reed L. Mosher
Automatic Data Processing Center
U. S. Army Engineer Waterways Experiment Station
P. O. Box 631, Vicksburg, Miss. 39180

Clifton C. Hamby
U. S. Army Engineer District, Vicksburg, P. O. Box 60, Vicksburg, Miss. 39180

Raymond Veselka
U. S. Army Engineer District, Galveston, P. O. Box 1229, Galveston, Tex. 77553

February 1981

Final Report

A report under the Computer-Aided Structural Engineering (CASE) Project

Approved For Public Release; Distribution Unlimited

Prepared for Office, Chief of Engineers, U. S. Army
Washington, D. C. 20314

and U. S. Army Engineer Division, Lower Mississippi Valley
P. O. Box 80, Vicksburg, Miss. 39180

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314

REPLY TO
ATTENTION OF:

DAEN-CWE-DS 23 February 1981

SUBJECT: Instruction Reports K-80-6, K-80-7, and K-81-3: The Basic User's Guide, User's Reference Manual, and Validation Report for a Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)

All Corps Elements with Civil Works Responsibilities

1. The subject reports document a computer program for analyzing and designing reinforced concrete retaining walls and floodwalls. This computer program was developed according to specifications provided by the members of the Computer-Aided Structural Engineering (CASE) Task Group for T-Walls. As is the goal with all CASE tasks, the intent is to make an organized, cost-effective computer solution available to the Corps' designers for use when the need arises.

2. Engineers will be readily able to tell by the description of the program and by the examples given in the reports of the applicability toward their needs. Detailed documentation of the program may be obtained from the Engineering Computer Programs Library (ECPL) of the U. S. Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss.

3. We strongly encourage the use of this program where applicable throughout the Corps.

FOR THE CHIEF OF ENGINEERS

LLOYD A. DUSCHA
Chief, Engineering Division
Directorate of Civil Works

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

14

WES-

1. REPORT NUMBER
Instruction [redacted] K-81-3

2. GOVT ACCESSION NO.
AD-A099 377

3. RECIPIENT'S CATALOG NUMBER

(9)

4. TITLE (and Subtitle)

6

VALIDATION REPORT: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS (TWDA)

5. TYPE OF REPORT & PERIOD COVERED
Final report

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

William A. Price
Robert L. Hall
Reed L. Mosher
Clifton C. Hamby
Raymond Veselka

8. CONTRACT OR GRANT NUMBER(s)

9. PERFORMING ORGANIZATION NAME AND ADDRESS
U. S. Army Engineer Waterways Experiment Station
Automatic Data Processing Center
P. O. Box 631, Vicksburg, Miss. 39180

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
Office, Chief of Engineers, Washington, D. C. 20314 and U. S. Army Engineer Division, Lower Mississippi Valley, P. O. Box 80, Vicksburg, Miss. 39180

12. REPORT DATE
February 1981

13. NUMBER OF PAGES
375

12

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

15. SECURITY CLASS. (of this report)
Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

This report was prepared under the Computer-Aided Structural Engineering (CASE) Project. A list of published CASE reports is printed on the inside of the back cover.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Computer programs
Computerized simulation
Design criteria
Floodwalls
Retaining walls

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents a series of example problems and their solutions that verify the accuracy of computer program TWDA (T wall design/analysis). TWDA is a user-oriented conversationally interactive, modular time-sharing program system for computer-aided structural design and analysis of inverted-T retaining walls and floodwalls founded on earth or rock. Its essential characteristics include:

a. List-directed input with prompting available on request or (Continued)

DD FORM 1473, 1 JAN 73 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

0381

20. ABSTRACT (Continued)

as shown to be needed. Data lists may be entered interactively or in a data file.

b. Design for minimum cost including excavation, backfill, slab concrete, and stem concrete, with inputted unit costs. Default is to design for minimum concrete volume.

c. Multiple soils strata may be used as existing and/or backfill earth. Either Coulomb's equation or trial wedges may be used to get active earth pressures.

d. Multiple slopes may be used to model existing and/or finished grade surfaces.

e. Time-sharing printout is limited to the minimum needed by the user to make his design decisions. A full analysis report is available in an optional output file that may be listed on any terminal.

f. The program is structured to permit easy updating as criteria change.

g. Up to 10 load cases may be used. The user does not need to reenter any data by hand into subsequent runs.

h. The 1977 edition of ACI code 318 is used. Default procedures conform to the Corps of Engineers' Engineer Manuals in effect in 1980. The user may, however, direct the program to change many of the standard procedures as needed.

i. Earthquakes may be considered using an acceleration factor that is applied to the static load.

j. Input data and output results may be displayed on a Tektronix 4014 terminal.

k. Multiple surcharges may be included in the data.

The program is divided into three major sections: the executive command phase, the stability group of modules, and the structural group of modules:

(a) The executive command phase is where the program starts executing and where is returns to after running the computational modules. Commands and data are entered in this phase of the program,

(b) The stability group of computational modules computes active earth pressures and determines overturning and sliding stability, AND

(c) The structural group of computational modules performs a stress analysis of the wall or designs for minimum slab thicknesses.

The philosophy of TWDA is to (a) ensure minimum-cost adequate design based on current codes and criteria, independent of the user's experience, and to (b) promote the use of personal judgment and imagination through man-machine interaction.

PREFACE

This report presents a validation of TWDA, a computer program for design and analysis of inverted-T retaining walls and floodwalls, by comparing computer program computations with hand calculations for a representative set of test problems. TWDA is a product of the Computer-Aided Structural Engineering (CASE) Project of the Office, Chief of Engineers, U. S. Army (OCE), and of the Computer-Aided Structural Design (CASD) Project of the U. S. Army Engineer Division, Lower Mississippi Valley (LMVD).

Mr. William A. Price, Chief, Computer-Aided Design Group (CADG), Automatic Data Processing (ADP) Center, U. S. Army Engineer Waterways Experiment Station (WES), provided the overall design of the program and led the program development team. The program was written by Mr. Price and Messrs. Robert L. Hall, H. Wayne Jones, Reed L. Mosher, and Michael E. George, all of the CADG. This report was written by Messrs. Price, Hall, and Mosher and Clifton C. Hamby, Vicksburg District, and Raymond Veselka, Galveston District. The work was managed and coordinated by Dr. N. Radhakrishnan, Special Technical Assistant, ADP Center, assisted by Mr. Paul K. Senter, CADG. Mr. Donald L. Neumann was Chief of the ADP Center. Mr. Donald R. Dressler was the point of contact in OCE.

The program was written according to specifications provided by the members of the CASE Task Group on T-Walls and of LMVD's CASD Committee and by other Corps personnel:

<u>CASE Task Group on T-Walls</u>

Victor M. Agostinelli, LMVD (Chairman)
Terry C. Cox, LMVD
Alvis Eikstrems, North Atlantic Division
Stacey Anastos, North Atlantic Division
Joseph V. Milliorn, formerly with the New Orleans District
Raymond Veselka, Galveston District

<u>LMVD's CASD Committee</u>

Victor M. Agostinelli, LMVD (Chairman)
Arvis R. Dennis, Vicksburg District
Clifton C. Hamby, Vicksburg District
Sefton B. Lucas, Memphis District
Joseph Barber, Memphis District

LMVD's CASD Committee (Continued)

James G. Bigham, New Orleans District
Joseph V. Milliorn, formerly with the New Orleans District
James J. Smith, St. Louis District
Thomas J. Mudd, St. Louis District
James Cronin, St. Louis District
Carlton Smith, St. Louis District

OCE (DAEN-CWE-DS) Personnel

Keith O. O'Donnell, former Chief, Structural Engineering Section (retired)
Donald R. Dressler
Lucian G. Guthrie

Other Corps Personnel

Carl E. Pace, Structures Laboratory, WES
William A. Price, ADP Center, WES
James D. Wall, South Atlantic Division

The hand calculations were performed by Messrs. Hamby, Price, and Veselka. The following WES personnel contributed to the coding of the program: Messrs. Price, Hall, Jones, Mosher, and George of the CADG and Messrs. Edward F. O'Neil III and Roy E. Campbell of the Structures Laboratory. Dr. William P. Dawkins, Oklahoma State University, and Dr. Michael W. O'Neill, University of Houston, contributed routines under contract to WES.

A basic user's guide and a user's reference manual will also be published by WES on TWDA. Documentation of the program specifications is available from LMVD.

Directors of WES during the development of this program were COL J. L. Cannon, CE, and COL N. P. Conover, CE. Technical Director was Mr. F. R. Brown.

CONTENTS

CONTENTS

CONTENTS

CONVERSION FACTORS, INCH-POUND TO METRIC (SI) UNITS OF MEASUREMENT

Inch-pound units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
cubic yards	0.7645549	cubic metres
feet	0.3048	metres
inches	2.54	centimetres
pounds (force)	4.448222	newtons
pound (force)-feet	1.355818	newton-metres
pounds (force) per foot	14.5939	newtons per metre
pounds (force) per square foot	47.88026	pascals
pounds (force) per square inch	6.894757	kilopascals
pounds (mass) per cubic foot	16.01846	kilograms per cubic metre
square inches	6.4516	square centimetres

VALIDATION REPORT: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF INVERTED-T RETAINING WALLS AND FLOODWALLS (TWDA)

CHAPTER 1: INTRODUCTION

1-1 PURPOSE OF REPORT. The purpose of this report is to verify the accuracy of the computations performed by computer program TWDA (Program No. 713-F3-R0-027).

1-2 SOURCES OF EXAMPLES. The examples presented herein are from three sources:

1-2-1 Examples 1 and 3 from the Basic User's Guide.*

1-2-2 Examples A and C from the User's Reference Manual.**

1-2-3 A series of hypothetical problems.

1-3 PRESENTATION

1-3-1 Each example is presented in the following manner:

a. Description of objectives of example.

b. Preparation of data for program.

c. Time-sharing terminal input/output.

d. Report file from high-speed printer.

e. Hand calculations.

f. Comparisons and commentary.

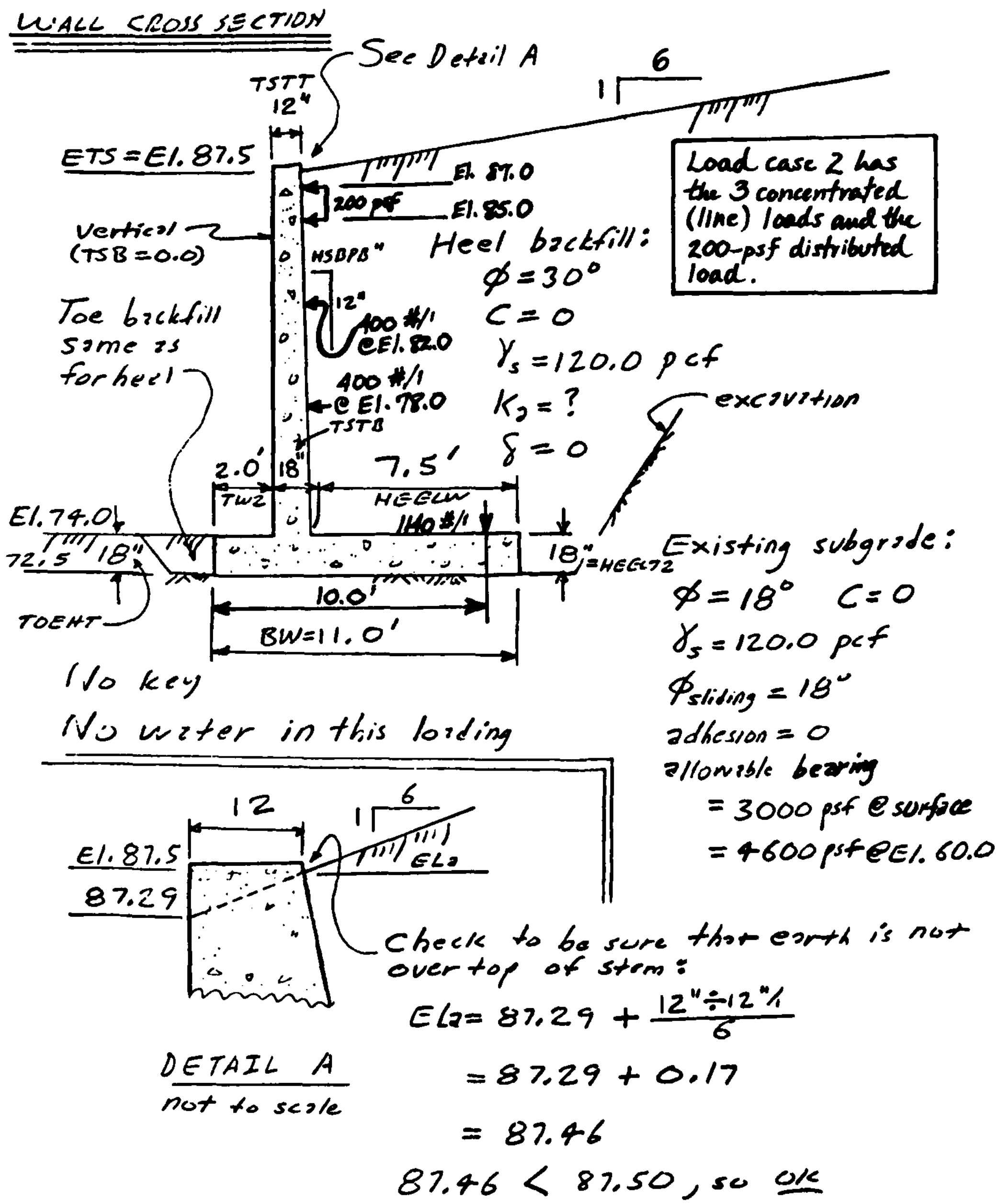
1-3-2 The first example is presented in more detail than the others to demonstrate the basic analyses and their methods of presentation. The rest of the examples are shown in only enough detail to demonstrate the particular additional feature(s) being tested in each example.

---

* Price, W. A. et al. 1980. "Basic User's Guide: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)," Instruction Report K-80-6, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

** ________. 1980. "User's Reference Manual: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)," Instruction Report K-80-7, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

2-1 DESCRIPTION OF PROBLEM. This problem is the same as example 1 in the Basic User's Guide; i.e., an analysis of a basic retaining wall with a sloping backfill and no water:



2-1-1 Load case 1 includes a homogeneous, cohesionless backfill over a cohesive subgrade in the consolidated, drained condition.

2-1-2 Load case 2 is like load case 1, plus direct loads are applied to the concrete stem and heel.

2-2 DATA PREPARATION. Chapter and paragraph references are to the Basic User's Guide:

Starting responses (paragraphs 7-2, 7-3 a)

INIT (because this is a new problem)

1 (how many load cases)

R (for retaining wall)

N (for non-hydraulic)

NAME EXAMPLE 1 -- BASIC RET WALL ANALYSIS

Selection of data lists needed (see paragraphs 3-2 & 8-1)

Use Modules FA for foundation analysis and WA for (working) stress analysis, therefore data lists SSHC, SST, SPE3, WLA, WLAB, WLAH, WLAS, WLAT, STLB, and STLS will be needed and the other lists mentioned in paragraph 8-1-3 may be used. A data list is one line of data, consisting of the list name followed by the desired values of the data items in that list. The lists may be entered in any order provided that the values in a list are in the proper order within the list. See also Chapter 5 for list preparation general rules.

Preparation of Data Lists (See paragraphs 8-3 thru 8-11)

Soil Surfaces (data lists beginning with letters "SS"):

* Over heel (for Coulomb's K_a), paragraph 8-3-1a

Data list name = SSHC

Use Load Case number LC=0 in case additional load cases are added later.

list name	LC	ESHW	HS3
SSHC	0	87.29	6

* Over Toe, paragraph 8-3-1 b — level grade, at elev. 74.0

list name	LC	ESTW	SST
SST	0	74.0	100.0

* Existing grade (list SSEE), paragraph 8-3-2
This list is not applicable to analysis, so is omitted.

Soils Properties (data lists beginning with the letters "SP"):

* Subgrade data list SPE3, paragraph 8-4-1

data list name	ϕ PHI3	c psf CON3	γ_s pcf GAMAS3	$\phi_{sliding}$ PHIS3	sliding adhesion psf ADHS3
SPE3	18	0	120	18	0

Allowable Bearing Pressures, psf: Top surface BW = BW1 ABP3TN	@ELBS3 BW=BW1 ABP3BN	Top surface BW=BW2 ABP3TW	@ELBS3 BW=BW2 ABP3BW	Elev. of bottom ELBS3
3000	4600	3000	4600	60.00

* Heel backfill (because ϕ, c, or γ_s is different from the subgrade), paragraph 8-4-2 a:

list name	LC	ϕ PHI1	c psf CON1	γ_s pcf GAMAS1	K_a RKA1	δ DELTA1	K_{ae} RKAE1	min heel cover feet HCMIN
SPH1	0	30	0	120	C	0	C	C

C because it is not applicable

* Toe backfill (because ϕ, c, or γ_s is different from the subgrade), paragraph 8-4-2 b:

list name	LC	ϕ PHI7	c, psf CON7	γ_s, pcf GAMAS7
SPT7	0	30	0	120

Surcharge & Direct Loads (paragraph 8-7-2)

★ Data List SCFD -- downward forces on concrete

list name	LC	PVS Lb/ft	PVB Lb/ft	DVB ft
SCFD	2	C	1140.0	8.0

★ Data List SCFH -- horizontal forces on concrete

list name	LC	PH1 Lb/ft	ELPH1 ft	PH2 Lb/ft	ELPH2 ft.
SCFH	2	400.0	82.0	400.0	78.0

★ Data List SCWH -- distributed horizontal loads

list name	LC	W1 psf	ELW1T ft	ELW1B ft	W3 psf	W4 psf
SCWH	2	200.0	87.0	85.0	C	C

terminate list here

* Over Toe, paragraph 8-3-1 b   level grade, at elev. 74.0

list name	LC	ESTW	SST
SST	0	74.0	100.0

* Existing grade (list SSEE), paragraph 8-3-2
This list is not applicable to analysis, so is omitted.

Soils Properties (data lists beginning with the letters "SP"):

* Subgrade data list SPE3, paragraph 8-4-1

data list name	ϕ PHI3	c psf CON3	γ_s pcf GAMAS3	$\phi_{sliding}$ PHIS3	sliding adhesion psf ADHS3
SPE3	18	0	120	18	0

Allowable Bearing Pressures, psf

Top surface BW = BW1 ABP3TN	@ELBS3 BW=BW1 ABP3BN	Top surface BW=BW2 ABP3TW	@ELBS3 BW=BW2 ABP3BW	Elev. of bottom ELBS3
3000	4600	3000	4600	60.00

* Heel backfill (because ϕ, c, or γ_s is different from the subgrade), paragraph 8-4-2 a:

list name	LC	ϕ PHI1	c psf CON1	γ_s pcf GAMAS1	K_a RKA1	δ DELTA1	K_{ae} RKAE1	min heel cover feet HCMIN
SPH1	0	30	0	120	C	0	C	C

C because it is not applicable

* Toe backfill (because ϕ, c, or γ_s is different from the subgrade), paragraph 8-4-2 b:

list name	LC	ϕ PHI7	c, psf CON7	γ_s, pcf GAMAS7
SPT7	0	30	0	120

Surcharge & Direct Loads (paragraph 8-7-2)

★ Data List SCFD -- downward forces on concrete

list name	LC	PVS Lb/ft	PVB Lb/ft	DVB ft
SCFD	2	C	1140.0	8.0

★ Data List SCFH -- horizontal forces on concrete

list name	LC	PH1 Lb/ft	ELPH1 ft	PH2 Lb/ft	ELPH2 ft.
SCFH	2	400.0	82.0	400.0	78.0

★ Data List SCWH -- distributed horizontal loads

list name	LC	W1 psf	ELW1T ft	ELW1B ft	W3 psf	W4 psf
SCWH	2	200.0	87.0	85.0	C	C

terminate list here

Soils Foundation Design Parameters (data list SOLP), paragraph 8-5-1:

RKH and RKV are not needed because no earthquake effects are included in the problem.

CFMA is not needed because the default value of 1 is acceptable with no arching active situation.

∴ the list is not needed.

Data list RRD is not applicable to investigation, so is not needed, paragraph 8-5-2

Water.- With no water, lists SEEP (para. 8-6-1) and BOIL (para 8-6-2) may be omitted.

Surcharges.- With no surcharges, the lists described in paragraph 8-7 may all be omitted.

Cost data are optional for investigation, so may be omitted (paragraph 8-11).

Wall Geometry, paragraph 8-8

Use data lists with names beginning with WLA, standing for "Wall Analysis"; Omit list WLAK as being optional when there is no key. See paragraphs 8-8-3 and 8-8-4 for definitions:

list name	ETS feet	TW2 feet	STR	HEELW feet
★ WLA	87.5	2.0	C	C

can be calculated from data items BW, TW2, TSTB

list name	BW feet	BW1 for $ABP3_B^T N$	BW2 for $ABP3_B^T W$	BS 0 = level
★ WLAB	11.0	11.0	12.0	0

list name	HEELT2 inches	HEELW feet	HEELT1 inches
* WLAH	18.0	S	18.0

already established in list WLA, so "same"

list name	TSTT inches	TSB in/ft.	TSTB inches	HSTPH feet	HSTPB in/ft	HSBPB in/ft
* WLAS	12.0	0.0	18.0	0.0	0.0	

no separate top panel

already defined by other stem data

list name	BTE1 feet	TOEHT inches	TS2	TW1 feet	TS1
* WLAT	72.5	18.0	100	0.0	100

always use TW1 = 0 when there is no break in slope on the toe top.

Now see if data list WLDS is needed for 12" TSTT value:

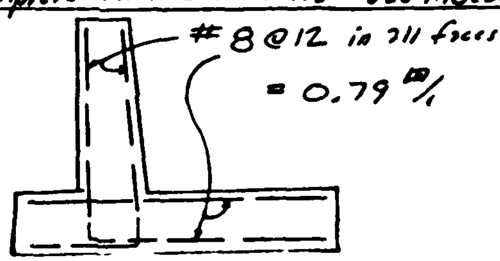
1. ETS − BTE1 = 87.5 − 72.5 = 15.0 feet high
2. Paragraph 8-8-2 b (2) says that the default for TMINS is 12 inches for heights up to 15 feet, so ok without needing list WLDS.
3. Note: If this list had been needed, it would have been entered thus:

list name	TMINS inches	TSB inches/ft.	HSTPH feet	HSTPB in/ft	HSBPB in/ft
WLDS	12.0	S	S	S	S

already established in data list WLAS

(The data are now complete for Module FA) -- add Module WA

Reinforcing Steel



* Bar Cover & Spacing, paragraph 8-9-2:
Default values are all acceptable, so none of these data lists need to be used.

* Stem, paragraph 8-9-3:

list name	LOC	ASTLST(LOC) in²/ft	LN	ASTLSH(LOC, LN) in²/ft
STLS	1	0.79	1	0.79

(end of stem)

Only one use of this list is needed because there is only one layer of steel in the heel-side face and because there are no bar cutoff points.

* Key, paragraph 8-9-4: This list is not needed because there is no key.

* Toe, paragraph 8-9-5 (a):
Location code LOC=1 at end of toe. Only one layer of steel in each face, no cutoff points:

list name	LOC	LNA	ASTLBT(LOC, LNA) in²/ft	LNB	ASTLBB(LOC, LNB)
STLB	1	1	0.79	1	0.79

* Heel, paragraph 8-9-5 (b):
Location code for "first" location at end of base
= BW+1.9999, discard decimals
= 11.5+1.999 = 13.4999 → 13

list name	LOC	LNA	ASTLBT(LOC, LNA) in²/ft	LNB	ASTLBB(LOC, LNB) in²/ft
STLB	13	1	0.79	1	0.79

(Note paragraph 8-9-6 a.)

Concrete Analysis Parameters, paragraph 8-10:

The default values are all acceptable, so these lists (CND, CNWD, STLD) are not needed.

Automatic Alternate Load Cases, paragraph 9-1:

"Do not use this" = zero for IFEM in data list CND; may be put in with list

list name	RATION E_s/E_c	FPCON f'_c, psi	ESTL psi	IFEM 0 or 1
CND	D	D	D	0

or interactively in Module WA -- do this way.

Data Finished -- Put into data file form:

```
1000  INIT
1010  1
1020  R
1030  N
1040  NAME   EXAMPLE 1 -- BASIC RET WALL ANALYSIS

2000  SSHC   0   87.29   6.0
2010  SST    0   74.0    100.0

3000  SPE3   18.0  0.0  120.0  18.0  0.0 3000.0 4600.0
                                      3000.0  4600.0  60.0
3010  SPH1   0   30.0  0.0  120.0  C  0.0  C  C
3020  SPT7   0   30.0  0.0  120.0

4000  WLA    87.5  2.0  C  C
4010  WLAB   11.5  11.0  12.0  0.0
4020  WLAH   18.0  S  18.0
4030  WLAS   12.0  0.0  18.0  0.0  0.0  C
4040  WLAT   72.5  18.0  100.0  0.0  100.0
5000  STLS   1  0.79  1  0.79
5010  STLB   1  1  0.79  1  0.79
5020  STLB   13  1  0.79  1  0.79
```

new data file lines to add load case 2:

```
1010  2
6000  SCFD  2  C  1140.0  8.0
6010  SCFH  2  400.0  82.0  400.0  78.0
6020  SCWH  2  200.0  87.0  85.0
7000  UPDATE
```

Name the revised data file EXV 1 DAT

DATA FILE:

```
•LIST EXV1DAT

1000 INIT
1010 2
1020 P
1030 N
1040 NAME  EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
2000 SSHC 0  87.29  6.0
2010 SST   0  74.0  100.0
3000 SPE3 18.0 0.0 120.0 18.0 0.0 3000.0 4600.0 3000.0 4600.0 60.0
3010 SPH1  0  30.0  0.0  120.0  C  0.0  C  C
3020 SPT7  0  30.0  0.0  120.0
4000 WLA   87.5  2.0  C  C
4010 WLAB  11.0  11.0  12.0  0.0
4020 WLAH  18.0  0  18.0
4030 WLAS  12.0  0.0  18.0  0.0  0.0  C
4040 WLAT  72.5  18.0  100.0  0.0  100.0
5000 STLS  1  0.79  1  0.79
5010 STLB  1  1  0.79  1  0.79
5020 STLB 13  1  0.79  1  0.79
6000 SCFD  2  C  1140.0  8.0
6010 SCFH  2  400.0  82.0  400.0  78.0
6020 SCWH  2  200.0  87.0  85.0
7000 UPDATE
```

2-3 TIME-SHARING TERMINAL INPUT/OUTPUT:

```
*FORTRAN
*RUN WESLIB/TWDA,R

        09/17/80    11.687

:

PROGRAM TWDA -- 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
       REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EXV1UPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?W.A.PRICE
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY

?EXV1DAT
PROCESSING DATA FILE...

NOT ENOUGH VALUES ENTERED IN DATA LIST - SCWH
TRAILING VALUES SET TO '0'

::
:: UPDATE FILE RESET
::

::
:: DATA FILE PROCESSING DONE
::
:: RETURN TO INTERACTIVE INPUT
::

COMMAND
?RUN FA


THE RESULTANT RATIO =       0.4139, FOR LOAD CASE  1


THE RESULTANT RATIO =       0.3914, FOR LOAD CASE  2


FINAL FACTOR OF SAFETY AGAINST SLIDING =     1.07, FOR LOAD CASE  1
BY SHEAR FRICTION METHOD
```

```
FINAL FACTOR OF SAFETY AGAINST SLIDING =      0.94, FOR LOAD CASE  2
BY SHEAR FRICTION METHOD


TOTAL CONCRETE VOLUME =          33.38 (CU FT   LF), FOR LOAD CASE  1


TOTAL CONCRETE VOLUME =          33.38 (CU FT   LF), FOR LOAD CASE  2

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
       (MAKE HARD COPY BEFORE CARRIAGE RETURN)
   OR 0 TO OMIT THE PLOTS
?0

::
:: UPDATE FILE RESET
::


::
:: COMMAND-DATA PHASE ENTERED
::

COMMAND
?RUN WA
::
:: BEGIN MODULE WA
::

ENTER 1 TO SEE A TABLE OF X AND Y CORNER COORDINATES
   OR 0 TO CONTINUE WITHOUT SEEING THE TABLE
?1
```

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	87.5000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	0.	74.0000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	0.	74.0000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-2.0000	74.0000	TOP OF TOEHT = AT OUTER END OF TW2
5	-2.0000	72.5000	TOE END OF BASE = AT BTE1
10	9.0000	72.5000	HEEL END OF BASE
11	9.0000	74.0000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	1.5000	74.0000	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.0000	87.5000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.0000	87.5000	TOP OF HEEL-SIDE FACE OF STEM
15	8.5000	72.5000	BOTTOM OF CUTOFF WALL UNDER KEY

```
TO GET DEFAULT VALUE FOR "IFEM", ANSWER NEXT QUESTION WITH A CARRIAGE RETURN:

*** IFEM IS NOT DEFINED, SO YOU MUST
    ENTER 0 TO USE LOAD CASES AS-IS
    OR    1 TO ALSO USE EM ALTERNATE SPECIAL LOADINGS
            (A CARRIAGE RETURN WILL INSERT THIS DEFAULT
            VALUE OF 1)
    OR    ? FOR MORE INFORMATION
    OR    C TO CONTINUE DATA CHECK WITHOUT COMPUTATIONS
    OR    * TO ABORT THE MODULE
?0

*
* BEGIN STRESS ANALYSIS
*

ENTER T TO GET THE ANALYSIS RESULTS AT YOUR TERMINAL
   OR R TO PUT THEM IN THE REPORT FILE
   OR B TO PUT THEM BOTH PLACES
?B

ENTER THE LOAD CASE NUMBER YOU WANT ANALYZED
   OR A ZERO FOR ALL LOAD CASES IN DATA LIST "CASE"
   OR * TO STOP THE MODULE
?0

*
* BEGIN STEM STRESS ANALYSIS
*

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *):
??
ANALYSIS TYPE SELECTION:
ENTER C FOR ANALYSIS AT CRITICAL SECTIONS
   OR S FOR ANALYSIS AT SELECTED LOCATIONS
   OR F FOR ANALYSIS AT 1-FOOT INTERVALS
   OR ? TO SEE A LIST OF CRITICAL SECTIONS
   OR N TO GO ON TO THE TOE
   OR R TO RESTART MODULE WA TO TAKE ANOTHER LOOK AT SOMETHING
   OR * TO STOP THE MODULE

SHEAR  MOMENT               CRITICAL SECTION LOCATIONS
-----  ------ ---------------------------------------------------
  X       X    BETWEEN TOP & BOTTOM PANELS ON HEEL-SIDE FACE (POINT 13)
          X    AT THE BASE
  X            ALTERNATE LOCATIONS:
                  IF THERE IS A TOE, THEN A DISTANCE D ABOVE THE BASE
                  IF NO TOE, THEN AT THE TOP OF THE BASE
  X            IMMEDIATELY BELOW CONCENTRATED FORCES PH1 AND PH2

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *):
?C
```

```
SHEAR AT A DISTANCE D ABOVE THE BASE--

--- SHEAR ANALYSIS AT ELEVATION    75.17  (+ V FROM TOP PUSHED TOWARD TOE) ---
LOAD       V          N (COMP +)       M         UNIT SHEAR    ALLOWABLE   ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS  PROVISION
----  ----------    ----------   -----------   -----------   -----------  ---------
 1      3643.6        2272.5       14726.         20.267        60.641     B.7.4.5
 2      4843.6        2272.5       22926.         26.942        60.641     B.7.4.5

MOMENT AT THE BASE--

FLEXURE ANALYSIS AT ELEVATION    74.00 (+ M = TENSION AT HEEL)
LOAD  N (COMP=+)       M            FC     FS
CASE  LB / SLICE  LB-FT/SLICE     PSI    PSI
----  ----------  -----------    -----  ------
 1       2531.         19227.     768.  18762.
 2       2531.         28827.    1125.  29000.

SHEAR IMMEDIATELY BELOW PH1--

--- SHEAR ANALYSIS AT ELEVATION    82.00  (+ V FROM TOP PUSHED TOWARD TOE) ---
LOAD       V          N (COMP +)       M         UNIT SHEAR    ALLOWABLE   ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS  PROVISION
----  ----------    ----------   -----------   -----------   -----------  ---------
 2      1507.0        909.05       2939.2         10.514        60.439     B.7.4.5

SHEAR IMMEDIATELY BELOW PH2--

--- SHEAR ANALYSIS AT ELEVATION    78.00  (+ V FROM TOP PUSHED TOWARD TOE) ---
LOAD       V          N (COMP +)       M         UNIT SHEAR    ALLOWABLE   ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS  PROVISION
----  ----------    ----------   -----------   -----------   -----------  ---------
 2      3305.4        1675.7       11566.         20.073        60.561     B.7.4.5

STEM ANALYSIS COMPLETE TO BASE

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR +):
?S

BEGIN ANALYSIS AT SELECTED SECTIONS
TOP OF STEM IS AT ELEV.    87.500, BOTTOM AT    74.000

ENTER THE ELEVATION TO BE ANALYZED
   OR D TO RETURN TO THE ANALYSIS TYPE SELECTION
   OR N, R, OR + FROM TYPE SELECTION
?74

SHEAR AND MOMENT AT ELEVATION   74.00
```

```
--- SHEAR ANALYSIS AT ELEVATION     74.00  (+ V FROM TOP PUSHED TOWARD TOE) ---
LOAD        V           N (COMP +)         M          UNIT SHEAR    ALLOWABLE   ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS PROVISION
----  ----------    ----------   -----------   -----------   ----------- ---------
 1      4220.4        2531.3        19227.         22.690        60.673     B.7.4.5
 2      5420.3        2531.3        28827.         29.141        60.673     B.7.4.5

FLEXURE ANALYSIS AT ELEVATION     74.00 (+ M = TENSION AT HEEL)
LOAD  N (COMP=+)          M          FC       FS
CASE  LB / SLICE    LB-FT/SLICE    PSI      PSI
----  ----------    -----------   -----   ------
 1        2531.         19227.     768.   18762.
 2        2531.         28827.    1125.   29000.

ENTER THE ELEVATION TO BE ANALYZED
   OR D TO RETURN TO THE ANALYSIS TYPE SELECTION
   OR N, R, OR * FROM TYPE SELECTION
?D

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *):
?N

*
* BEGIN TOE STRESS ANALYSIS
*

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *):
??
ANALYSIS TYPE SELECTION:
ENTER C FOR ANALYSIS AT CRITICAL SECTIONS
   OR S FOR ANALYSIS AT SELECTED LOCATIONS
   OR F FOR ANALYSIS AT 1-FOOT INTERVALS
   OR ? TO SEE A LIST OF CRITICAL SECTIONS
   OR N TO GO ON TO THE KEY
   OR R TO RESTART MODULE WA TO TAKE ANOTHER LOOK AT SOMETHING
   OR * TO STOP THE MODULE
```

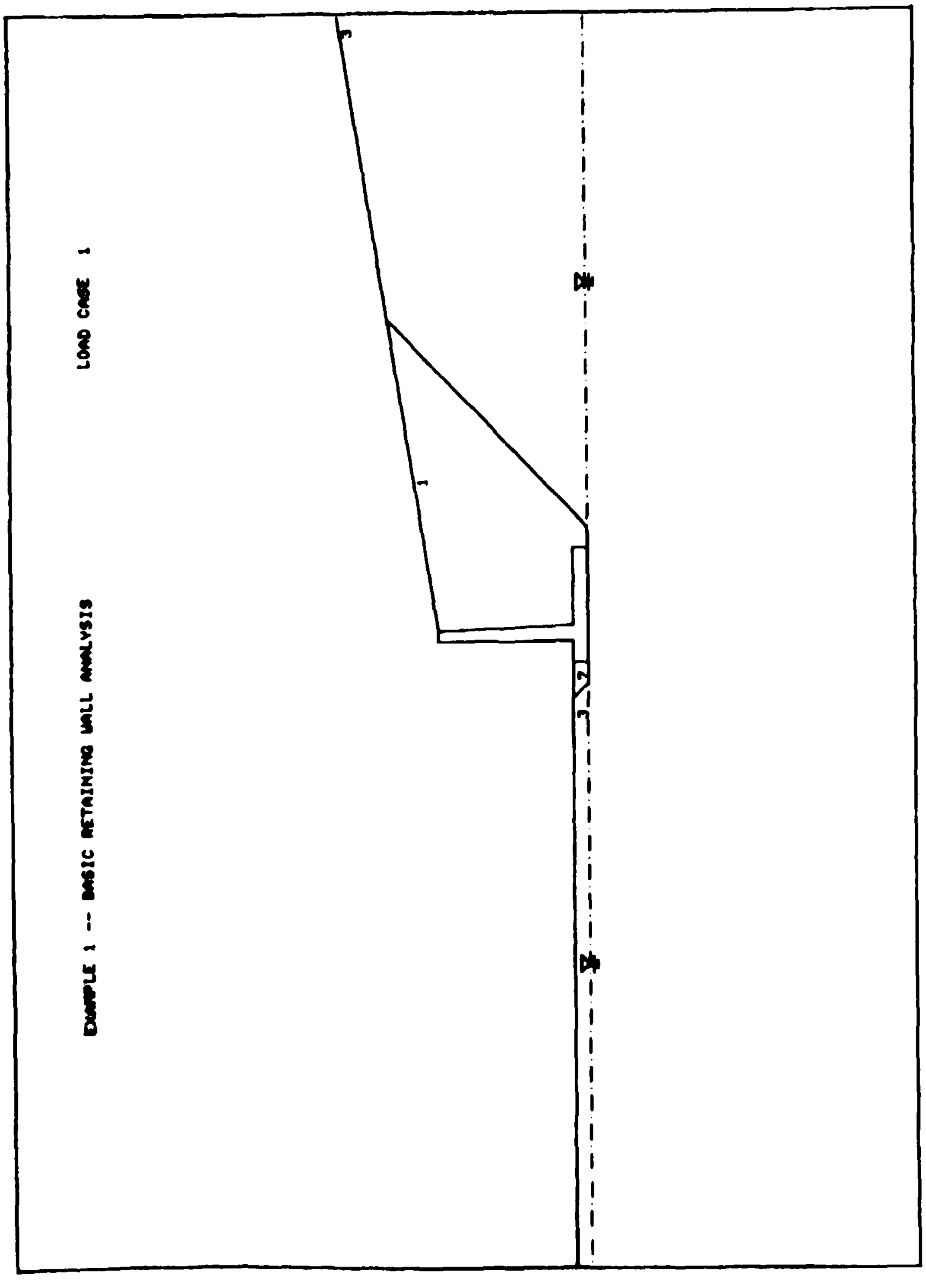
```
SHEAR  MOMENT          CRITICAL SECTION LOCATIONS
-----  ------  ------------------------------------------
  X       X    BETWEEN PANELS 1 (BY STEM) AND 2 (OUTER)
  X            AT A DISTANCE D FROM THE STEM
          X    AT THE STEM (POINT 2)
          X    IMMEDIATELY TOWARD STEM FROM FORCE PVB

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *):
?C


SHEAR AT A DISTANCE D FROM THE STEM--
---> ANALYSIS WITHIN 1-FOOT OF END OF TOE IS MEANINGLESS <---


MOMENT AT THE STEM (POINT 2)--

FLEXURE ANALYSIS AT X = -0.001  ( 1.999 FROM END OF TOE)  (+ M = TENSION IN TOP)
LOAD  N (COMP=+)        M          FC      FS
CASE  LB / SLICE  LB-FT/SLICE     PSI     PSI
----  ----------  -----------    -----  ------
 1         8.         -4344.     180.   4959.
 2       837.         -4859.     217.   4931.

TOE ANALYSIS COMPLETE TO STEM

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *):
?S

BEGIN ANALYSIS AT SELECTED SECTIONS
END OF TOE IS AT X =  -2.000, STEM FACE AT   0.
POINT BETWEEN TOP SLOPE PANELS IS AT   0.

ENTER THE X-COORDINATE (DIST FROM BASIC WORK POINT)
   OR D TO RETURN TO THE ANALYSIS TYPE SELECTION
(OMIT SIGN OF X)
   OR N, R, OR * FROM TYPE SELECTION
?0.001


SHEAR AND MOMENT AT X =  -0.001

--- SHEAR ANALYSIS AT X = -0.001  ( 1.999 FROM END OF TOE)  (+ V = END DOWN) ---
LOAD       V          N (COMP +)        M          UNIT SHEAR   ALLOWABLE   ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE   STRESS  PSI  UNIT STRESS PROVISION
----  ----------    ----------   -----------   -----------  ----------- ---------
 1    -4245.1         8.0187       -4344.2        24.397       60.251    B.7.4.5
 2    -4926.7       837.47         -4858.6        28.314       60.390    B.7.4.5

FLEXURE ANALYSIS AT X = -0.001  ( 1.999 FROM END OF TOE)  (+ M = TENSION IN TOP)
LOAD  N (COMP=+)        M          FC      FS
CASE  LB / SLICE  LB-FT/SLICE     PSI     PSI
----  ----------  -----------    -----  ------
 1         8.         -4344.     180.   4959.
 2       837.         -4859.     217.   4931.
```

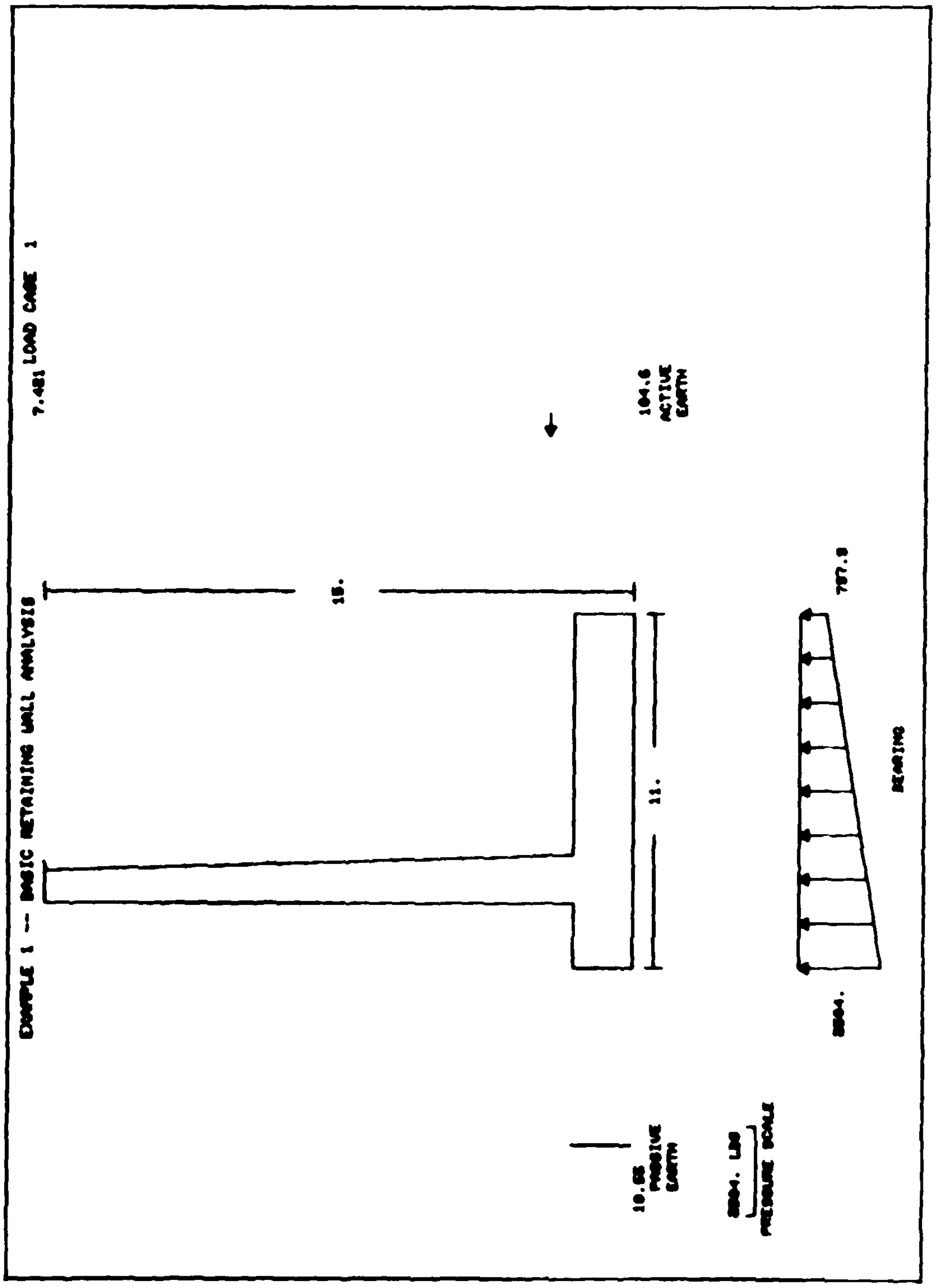
```
ENTER THE X-COORDINATE (DIST FROM BASIC WORK POINT)
   OR D TO RETURN TO THE ANALYSIS TYPE SELECTION
(OMIT SIGN OF X)
   OR N, R, OR * FROM TYPE SELECTION
?N

*
* BEGIN HEEL STRESS ANALYSIS
*

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *):
??
ANALYSIS TYPE SELECTION:
ENTER C FOR ANALYSIS AT CRITICAL SECTIONS
   OR S FOR ANALYSIS AT SELECTED LOCATIONS
   OR F FOR ANALYSIS AT 1-FOOT INTERVALS
   OR ? TO SEE A LIST OF CRITICAL SECTIONS
   OR N TO GO ON TO THE END
   OR R TO RESTART MODULE WA TO TAKE ANOTHER LOOK AT SOMETHING
   OR * TO STOP THE MODULE

SHEAR  MOMENT       CRITICAL SECTION LOCATIONS
-----  ------  ----------------------------------------------
  X       X    AT THE STEM (POINT 12)
  X       X    AT KEY FACE TOWARD THE STEM (POINT 6)
                  (IF KEY UNDER HEEL AND OVER 0.1 FT.)

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *):
?C


SHEAR AND MOMENT AT THE STEM--

--- SHEAR ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+V = END DOWN) ---
LOAD       V         N (COMP +)       M         UNIT SHEAR   ALLOWABLE   ACI318-77
CASE  LB / SLICE   LB / SLICE   LB-FT/SLICE   STRESS  PSI  UNIT STRESS  PROVISION
----  ----------   ----------   -----------   -----------  -----------  ---------
 1      3940.7       1218.0       20848.        21.187        60.453    B.7.4.5
 2      4995.8       473.74       29234.        26.859        60.329    B.7.4.5

FLEXURE ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+M = TENSION IN TOP)
LOAD  N (COMP=+)       M         FC      FS
CASE  LB / SLICE  LB-FT/SLICE   PSI     PSI
----  ----------  -----------  -----  ------
 1       1218.        20848.    802.  21394.
 2        474.        29234.   1099.  30849.

HEEL ANALYSIS COMPLETE TO END

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *):
?N

*
* MODULE WA COMPLETE
*
```

```
*
* UPDATE FILE RESET
*


*
* COMMAND-DATA PHASE ENTERED
*

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?5
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
?R0

SNUMB # 2393A


YOUR UPDATE FILE FOR FUTURE RESTART IS NAMED EXV1UPD
STOP     OK (RELEASE UNNEEDED FILES)

*
```

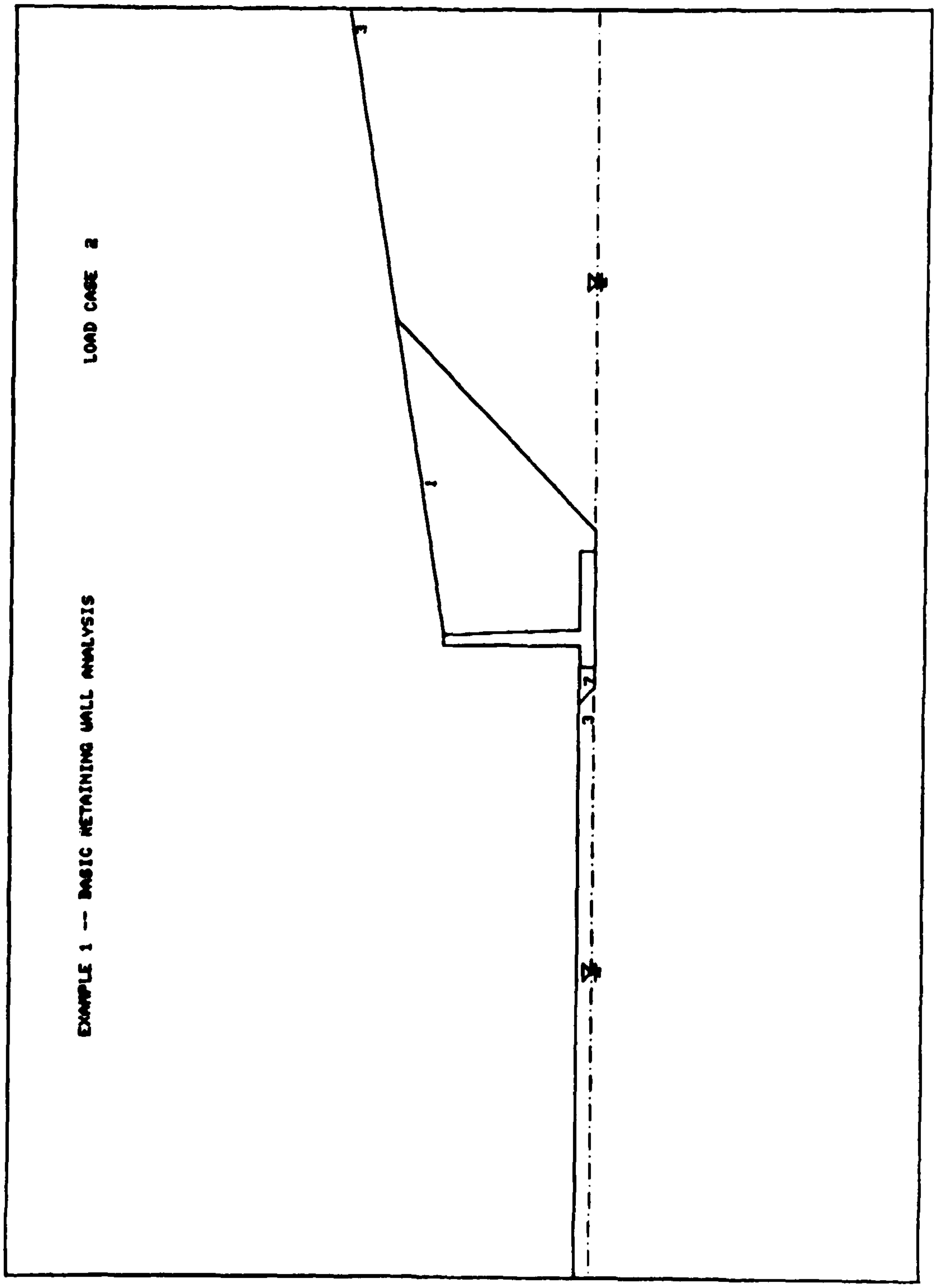
```
$FRN UESLIB/TUDA,R

        09/17/80    20.058


PROGRAM TUDA -- 713-F3-R0 087
   T-UALL DESIGN/ANALYSIS
       REL 1.0  AUG 80

(RESPOND UITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?KACX


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?U.A.PRICE.
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIUELY
?


IS THIS AN INITIAL RUN OR A RESTART OF A PREVIOUS RUN?
ENTER 'INIT' OR 'REST'

COMMAND
?REST EXU1UPD

$- ALL DATA RESET FOR FRESH START -$
$- COMMON DATA RESET FROM RESTART FILE EXU1UPD , UPDATE FILE RESET -$

COMMAND
?RUN FA


THE RESULTANT RATIO =      0.4139, FOR LOAD CASE  1


THE RESULTANT RATIO =      0.3914, FOR LOAD CASE  2


FINAL FACTOR OF SAFETY AGAINST SLIDING =     1.07, FOR LOAD CASE  1
BY SHEAR FRICTION METHOD


FINAL FACTOR OF SAFETY AGAINST SLIDING =     0.94, FOR LOAD CASE  2
BY SHEAR FRICTION METHOD


TOTAL CONCRETE VOLUME =         33.38 (CU FT / LF), FOR LOAD CASE  1


TOTAL CONCRETE VOLUME =         33.38 (CU FT / LF), FOR LOAD CASE  2

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
   OR 0 TO OMIT THE PLOTS
?1
```

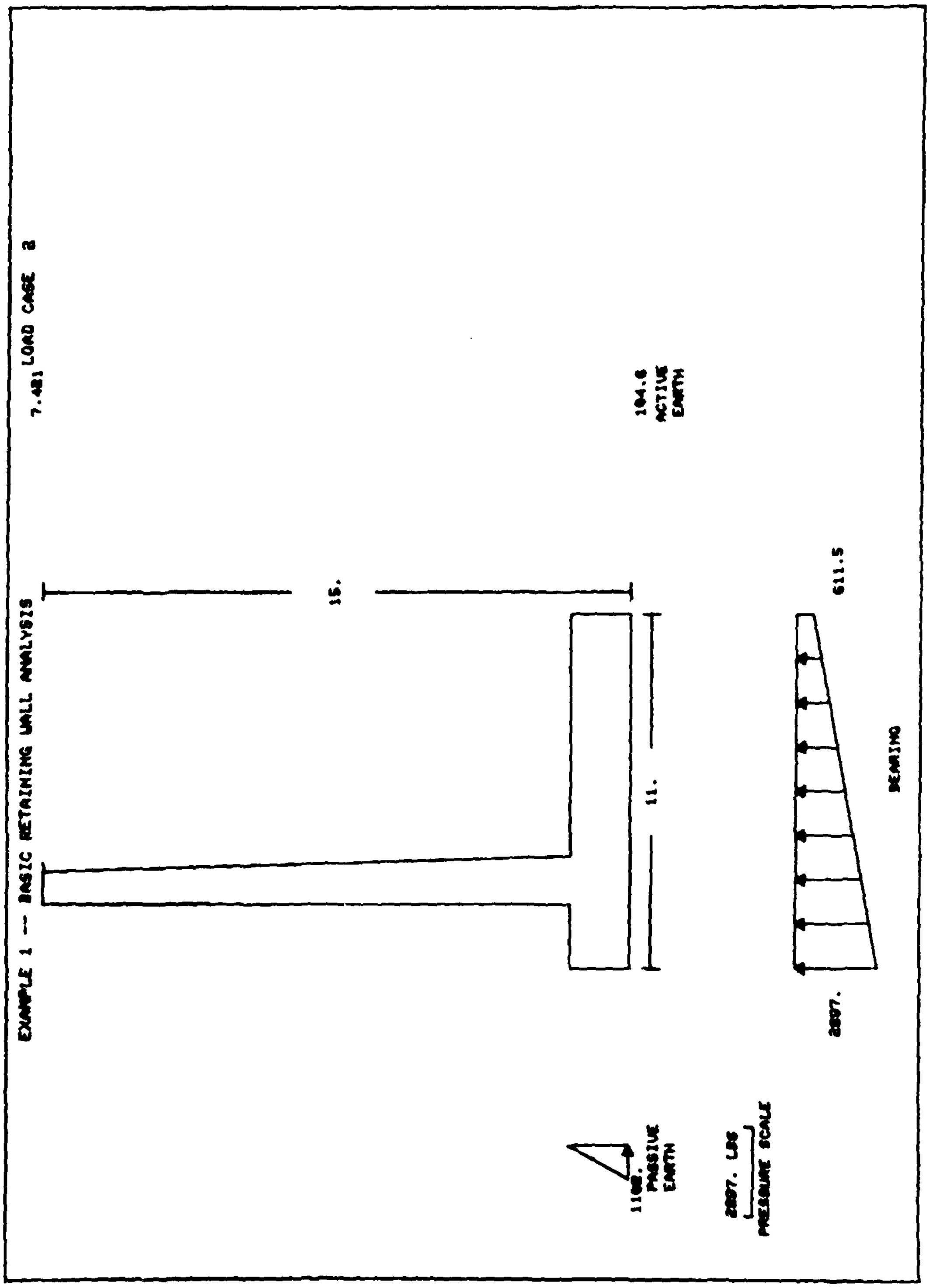
```
NOTE ---- A BELL WILL RING AT SELECTED TIMES
          TO ALLOW YOU TO MAKE A HARDCOPY IF
          YOU SO DESIRE. TO RESUME EXECUTION
          SIMPLY ENTER A CARRIAGE RETURN

ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      3 TO TERMINATE GRAPHICS
?1
ACTIVE LOAD CASES
------ ---- -----
                1
                2
ENTER DESIRED ACTIVE LOADCASE
?1
```


EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 1
1
2
3
3


EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
7.481
LOAD CASE 1
104.6
ACTIVE
EARTH
15.
11.
BEARING
PASSIVE
EARTH
PRESSURE SCALE

```
ENTER AN X TO RETURN OR ANOTHER LOADCASE SELECTION
?2
```

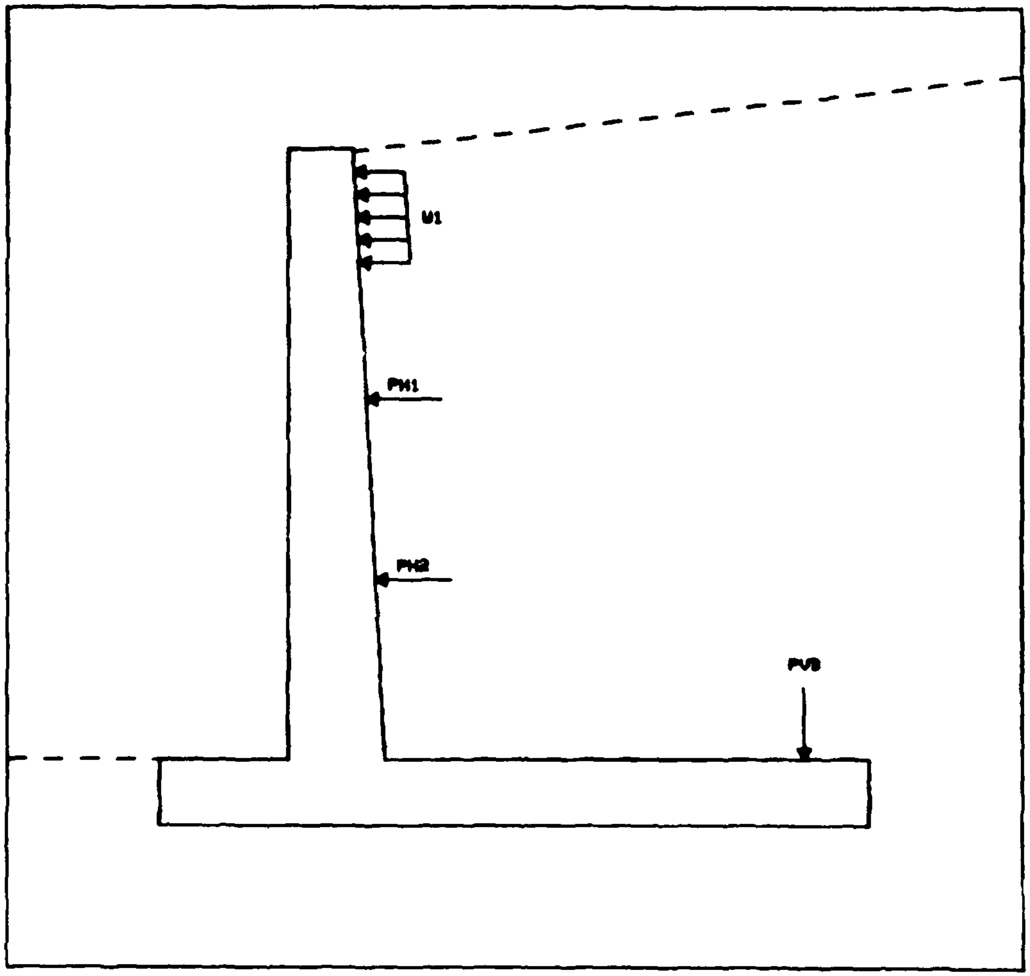

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 2


EXAMPLE 1 --- BASIC RETAINING WALL ANALYSIS
7.481
LOAD CASE 2
15.
11.
104.6
ACTIVE
EARTH
611.5
BEARING
2897.
1108.
PASSIVE
EARTH
2897. LBS
PRESSURE SCALE

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS LOAD CASE 2

LEGEND

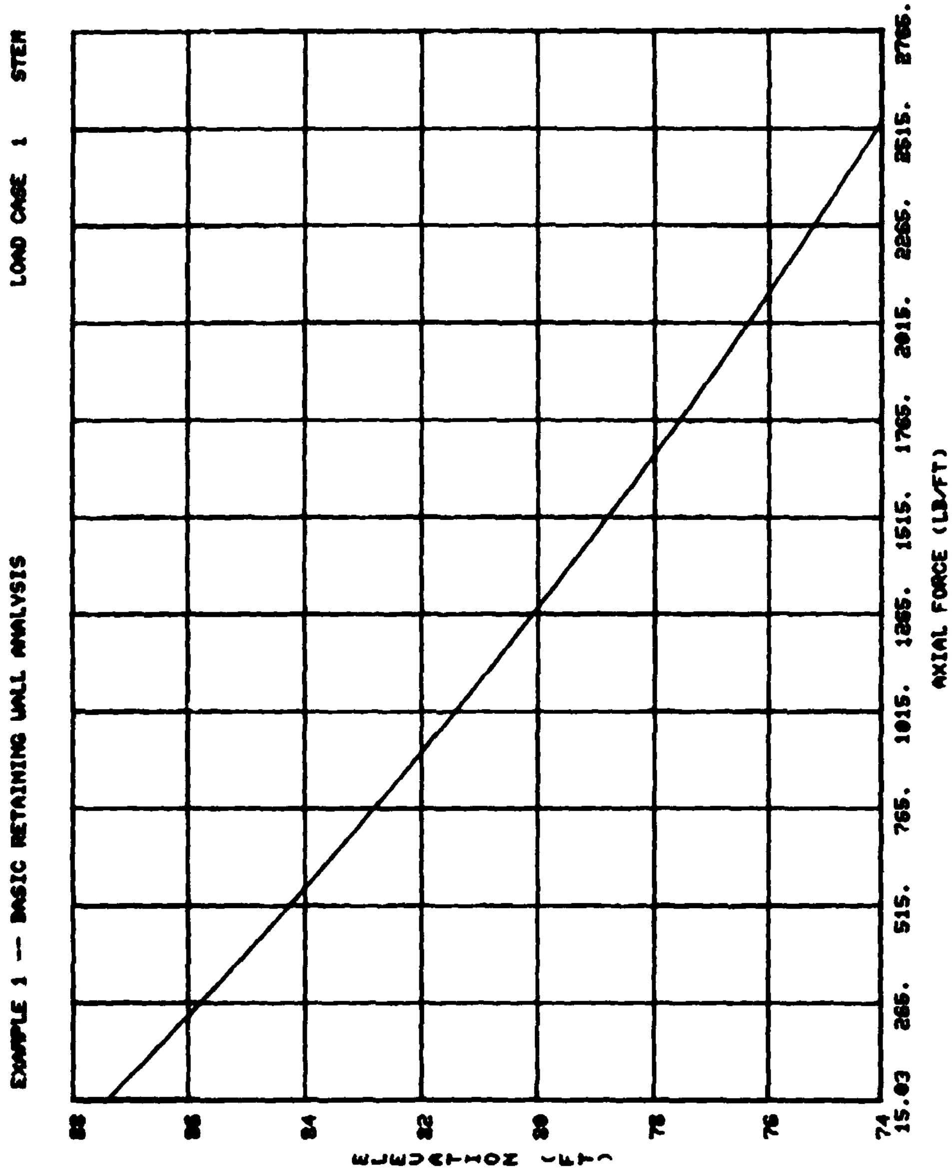
PH1(52.00) = 400.0000 PSF
PH2(78.00) = 400.0000 PSF
PVB(8.00) = 1140.0000 PSF
W1 = 300.0000 PSF
ELW1T = 87.0000 FEET
ELW1B = 85.0000 FEET

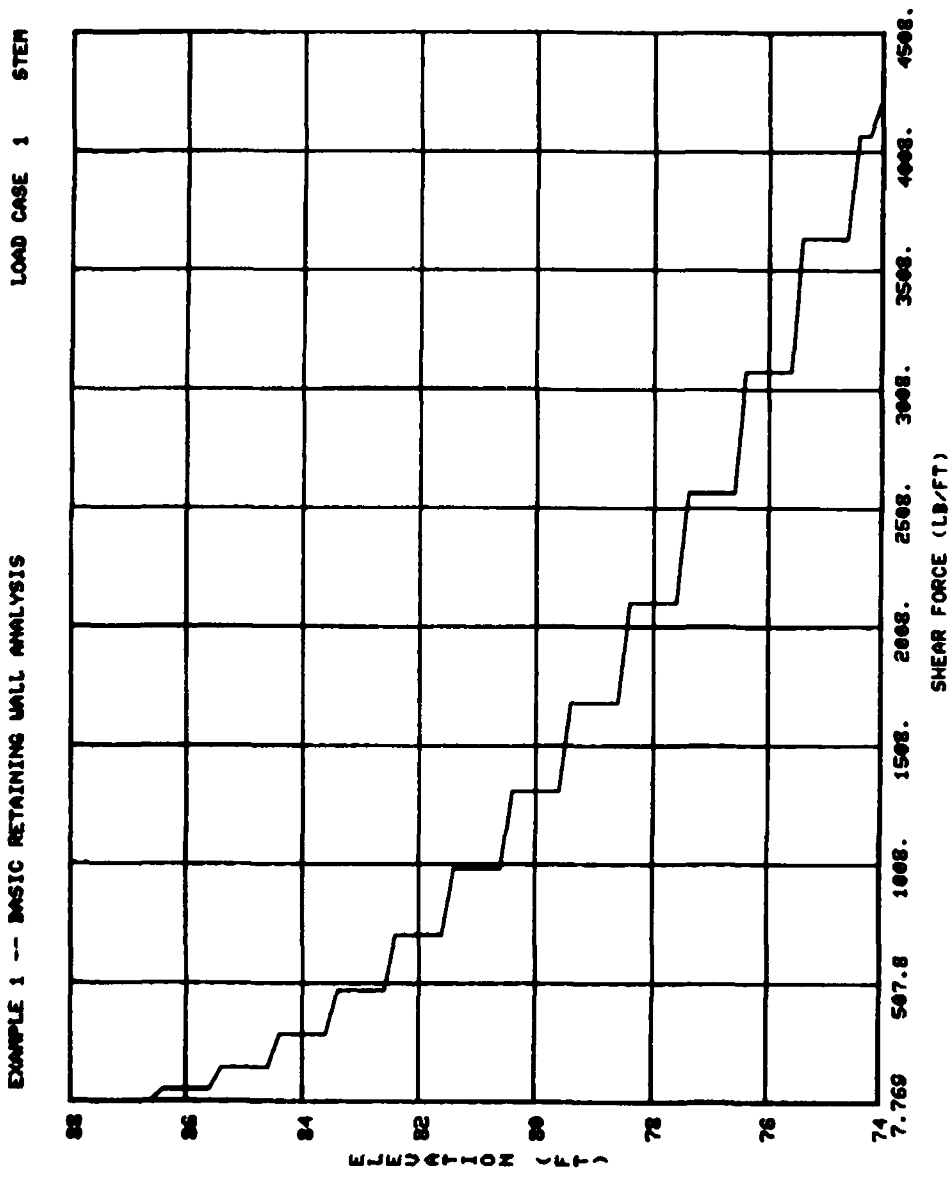


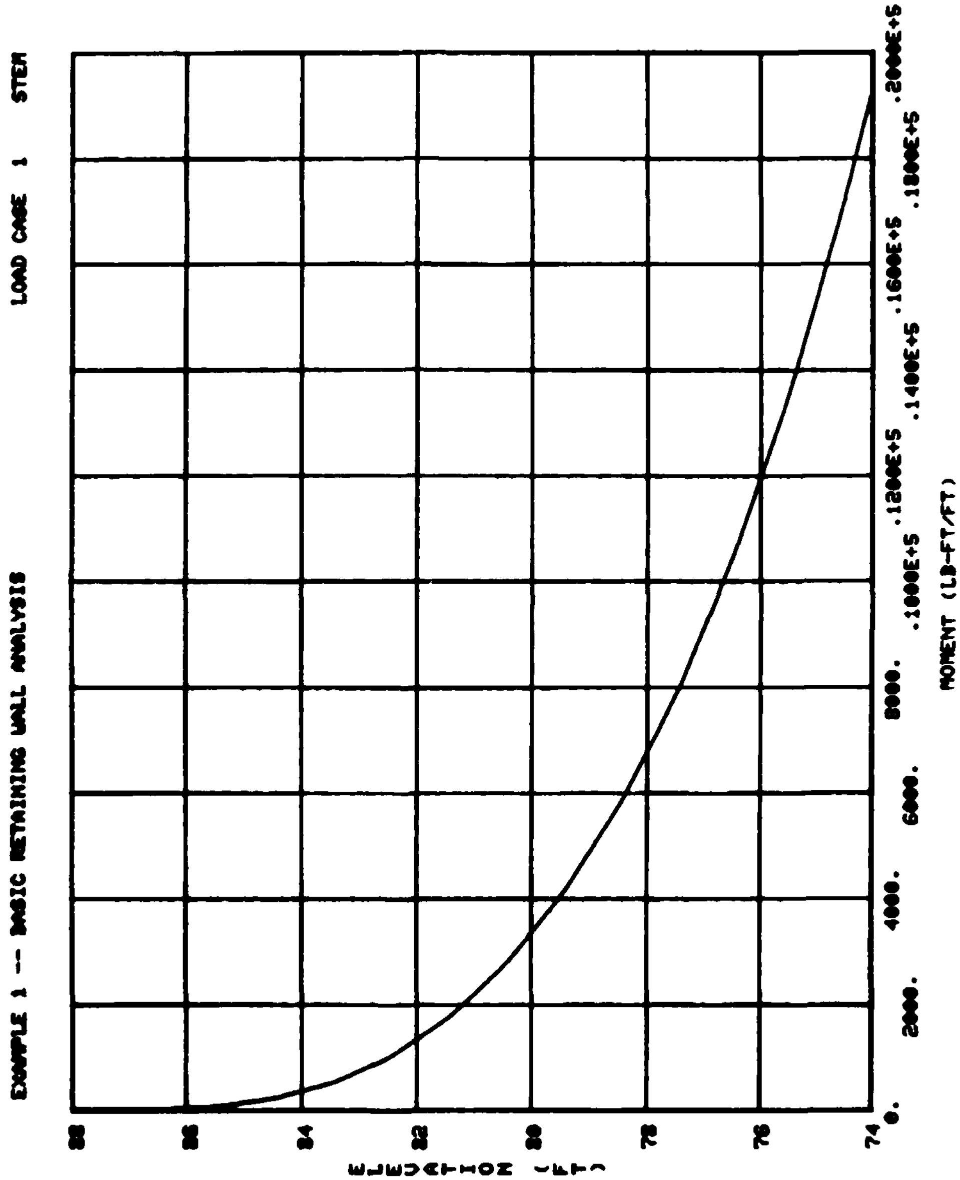
```
ENTER AN * TO RETURN OR ANOTHER LOADCASE SELECTION
?*
```

```
ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      * TO TERMINATE GRAPHICS
?2
ACTIVE LOAD CASES
****** **** *****
                 1
                 2
ENTER DESIRED ACTIVE LOADCASE
?1
TYPE IN MEMBER NUMBER (1-4)
     STEM --- 1
     TOE  --- 2
     KEY  --- 3
     HEEL --- 4
?1
```

```
WHAT PLOT DO YOU DESIRE
TYPE 1 --- AXIAL FORCE
     2 --- SHEAR FORCE
     3 --- MOMENT
     4 --- ALL PLOTS
    >4 --- RETURN
?4
```


EXAMPLE 1 — BASIC RETAINING WALL ANALYSIS
LOAD CASE 1
STEM
AXIAL FORCE (LB/FT)
ELEVATION (FT)
15.03
265.
515.
765.
1015.
1265.
1515.
1765.
2015.
2265.
2515.
2765.
88
86
84
82
80
78
76
74

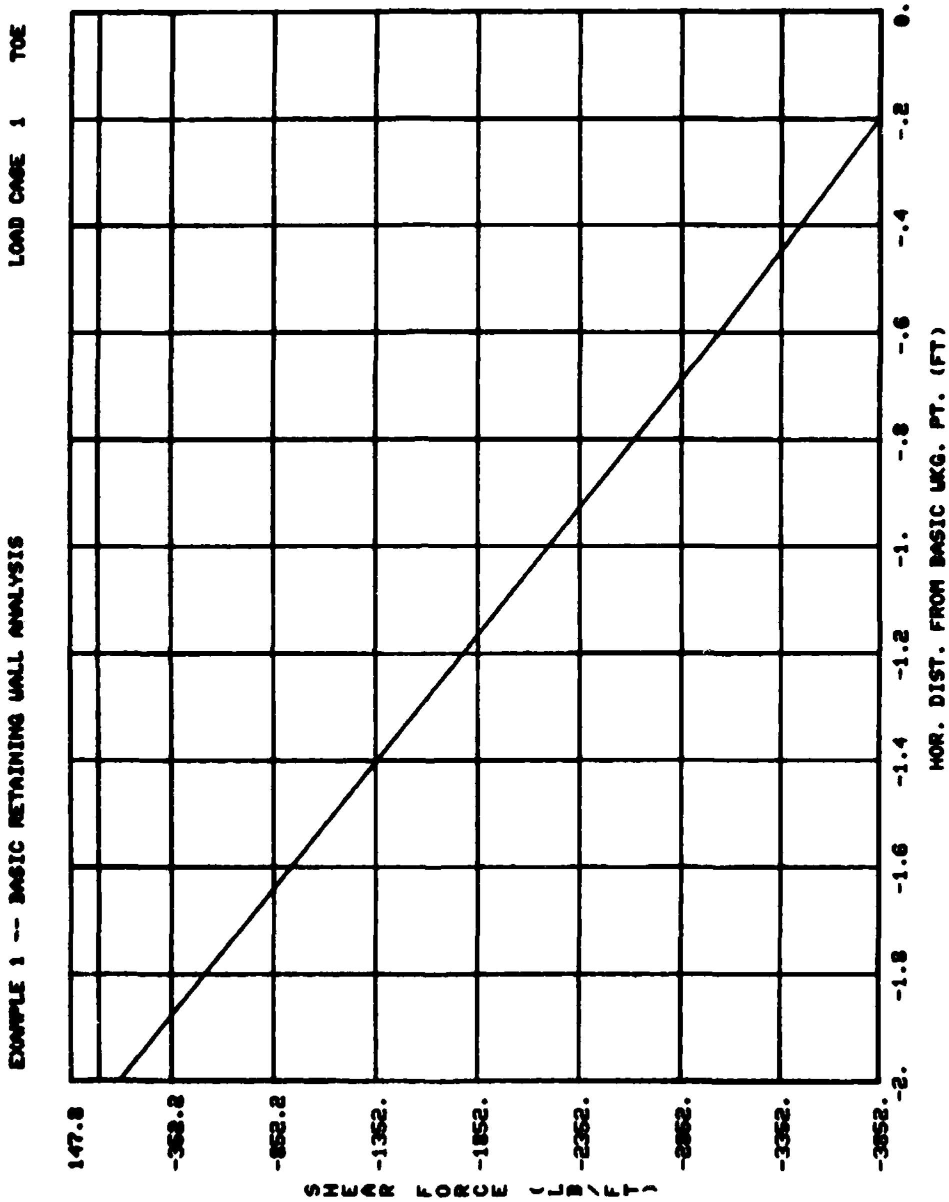

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 1
STEM
ELEVATION (FT)
88
86
84
82
80
78
76
74
7.769
507.8
1008.
1508.
2008.
2508.
3008.
3508.
4008.
4508.
SHEAR FORCE (LB/FT)

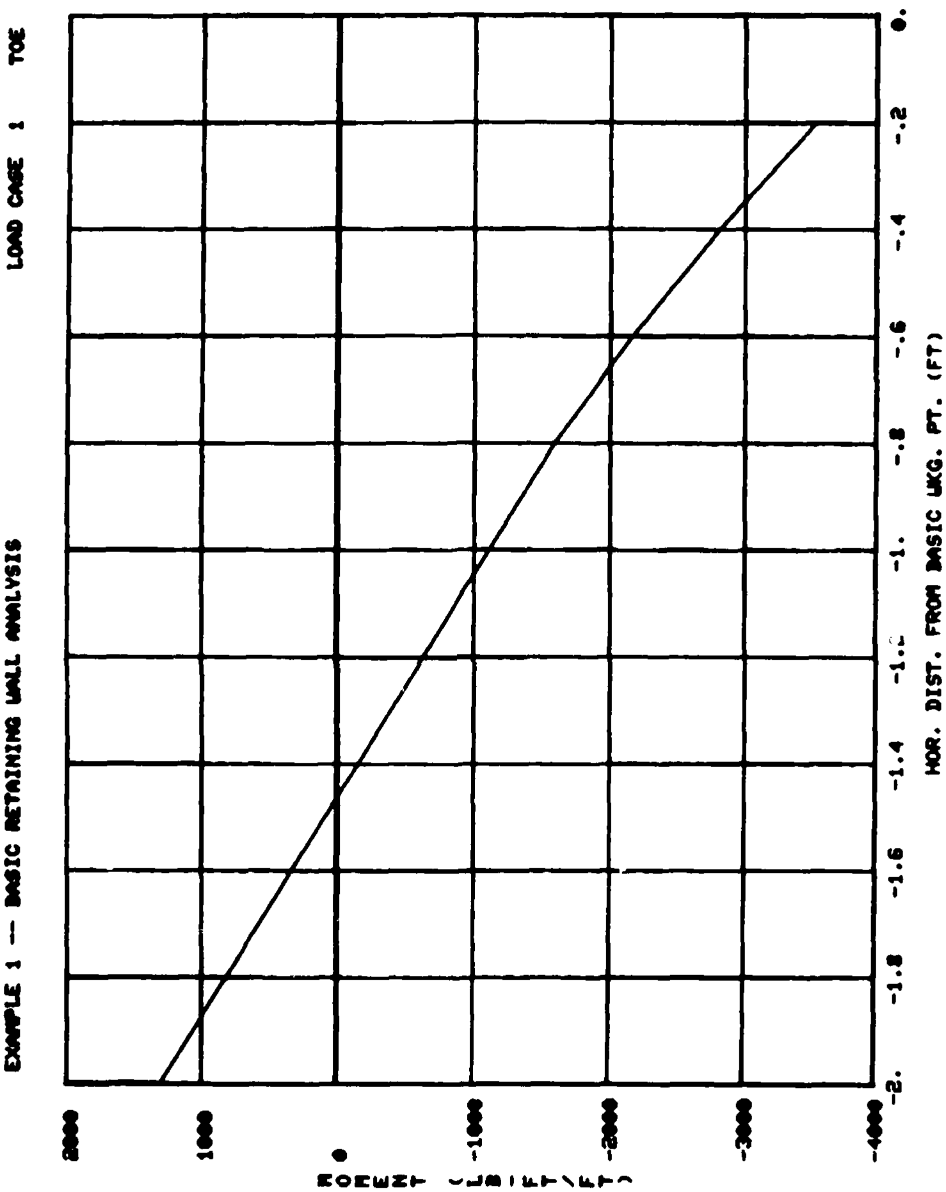

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 1
STEM
ELEVATION (FT)
88
86
84
82
80
78
76
74
0.
2000.
4000.
6000.
8000.
.1000E+5
.1200E+5
.1400E+5
.1600E+5
.1800E+5
.2000E+5
MOMENT (LB-FT/FT)

```
ENTER 1 TO PLOT ANOTHER MEMBER
      0 TO CONTINUE
?1
TYPE IN MEMBER NUMBER (1-4)
     STEM --- 1
     TOE  --- 2
     KEY  --- 3
     HEEL --- 4
?2
```

```
WHAT PLOT DO YOU DESIRE
TYPE 1 --- AXIAL FORCE
     2 --- SHEAR FORCE
     3 --- MOMENT
     4 --- ALL PLOTS
    >4 --- RETURN
?4
```

```
THE AXIAL FORCE IS CONSTANT =      8.019 LB/FT FOR THE TOE  --- LOAD CASE  1
```

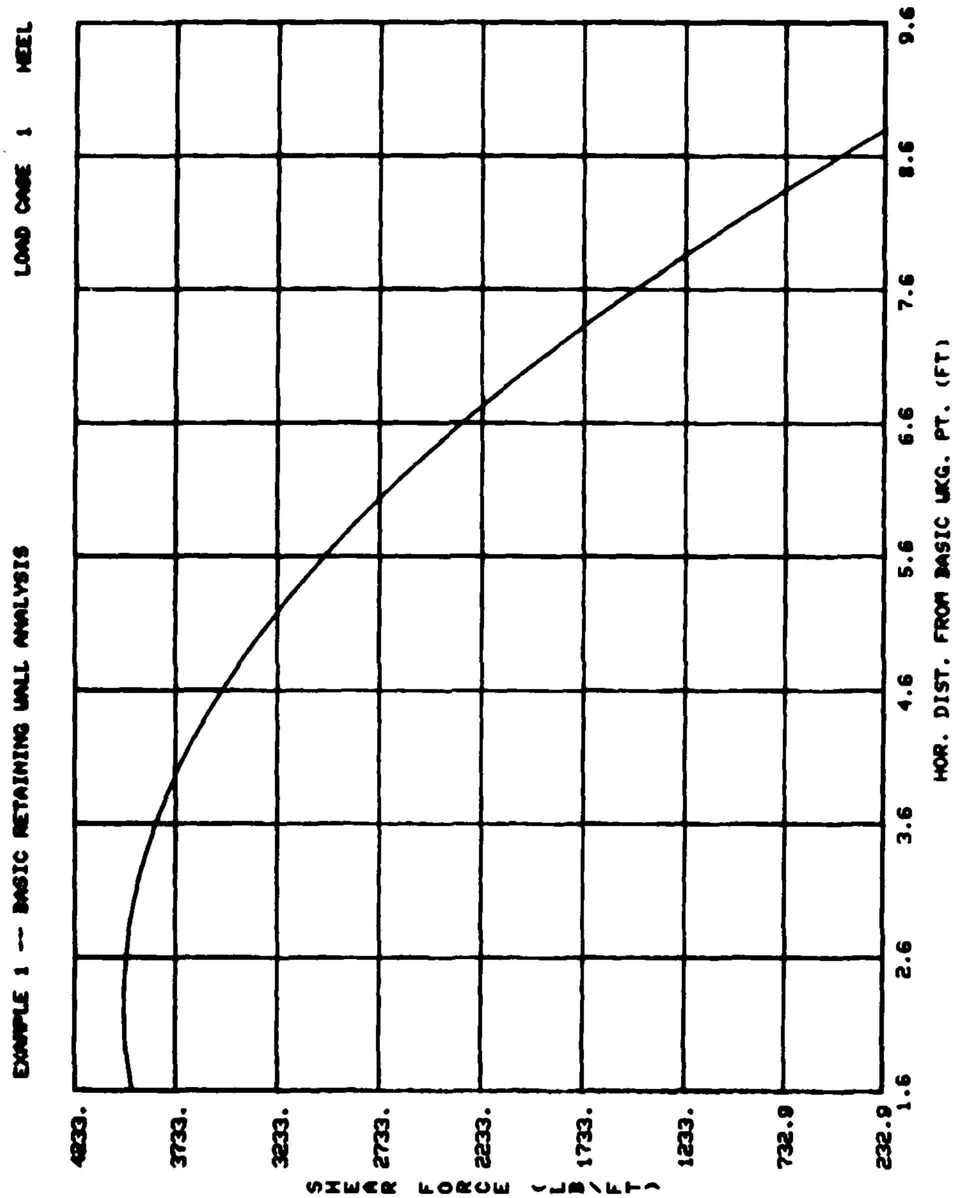

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 1 TOE
147.8
-352.2
-852.2
-1352.
-1852.
-2352.
-2852.
-3352.
-3852.
0.
-.2
-.4
-.6
-.8
-1.
-1.2
-1.4
-1.6
-1.8
-2.
HOR. DIST. FROM BASIC WKG. PT. (FT)

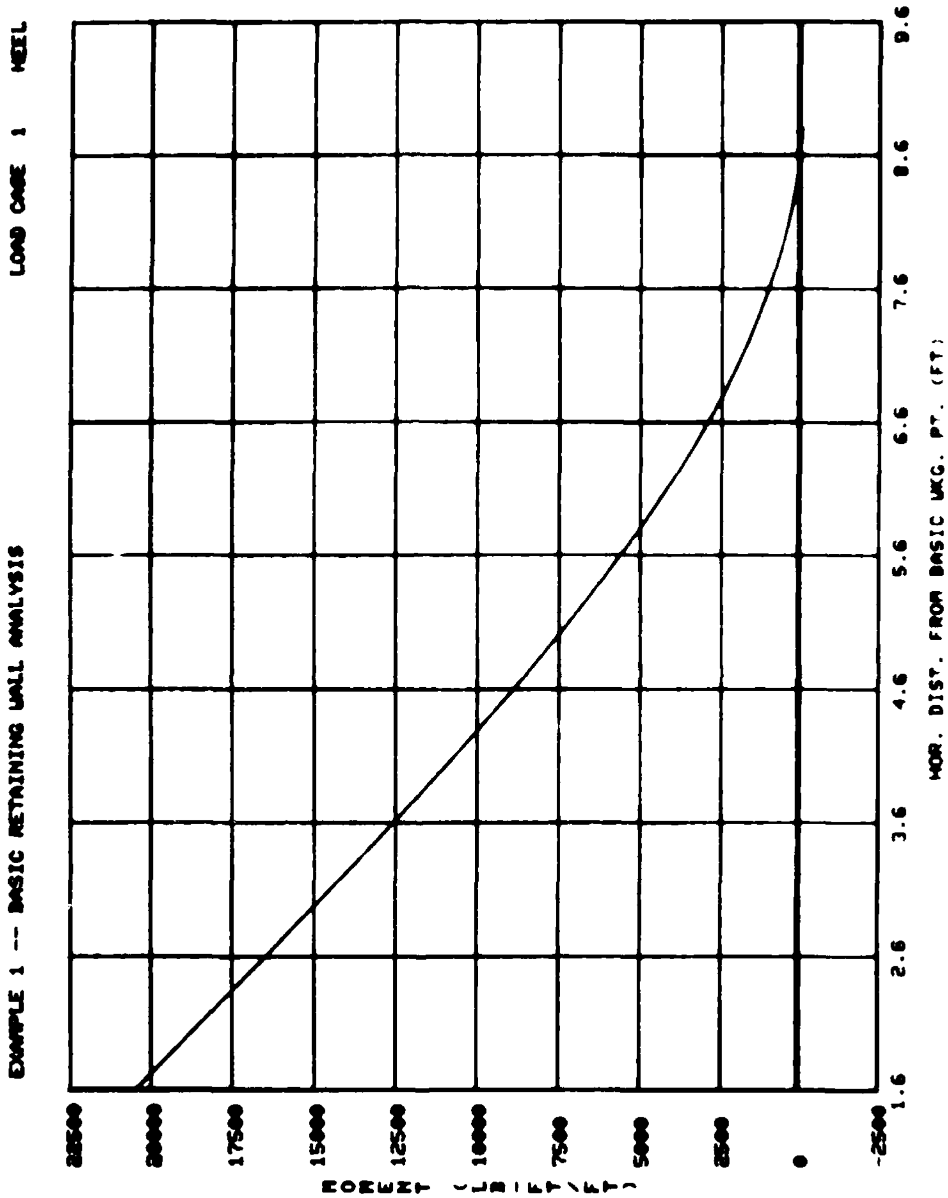

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 1
TOE
2000
1000
0
-1000
-2000
-3000
-4000
0.
-.2
-.4
-.6
-.8
-1.
-1.4
-1.6
-1.8
-2.
HOR. DIST. FROM BASIC WKG. PT. (FT)

```
ENTER 1 TO PLOT ANOTHER MEMBER
      0 TO CONTINUE
?1
TYPE IN MEMBER NUMBER (1-4)
     STEM --- 1
     TOE  --- 2
     KEY  --- 3
     HEEL --- 4
?4
```

```
WHAT PLOT DO YOU DESIRE
TYPE 1 --- AXIAL FORCE
     2 --- SHEAR FORCE
     3 --- MOMENT
     4 --- ALL PLOTS
    >4 --- RETURN
?4
```

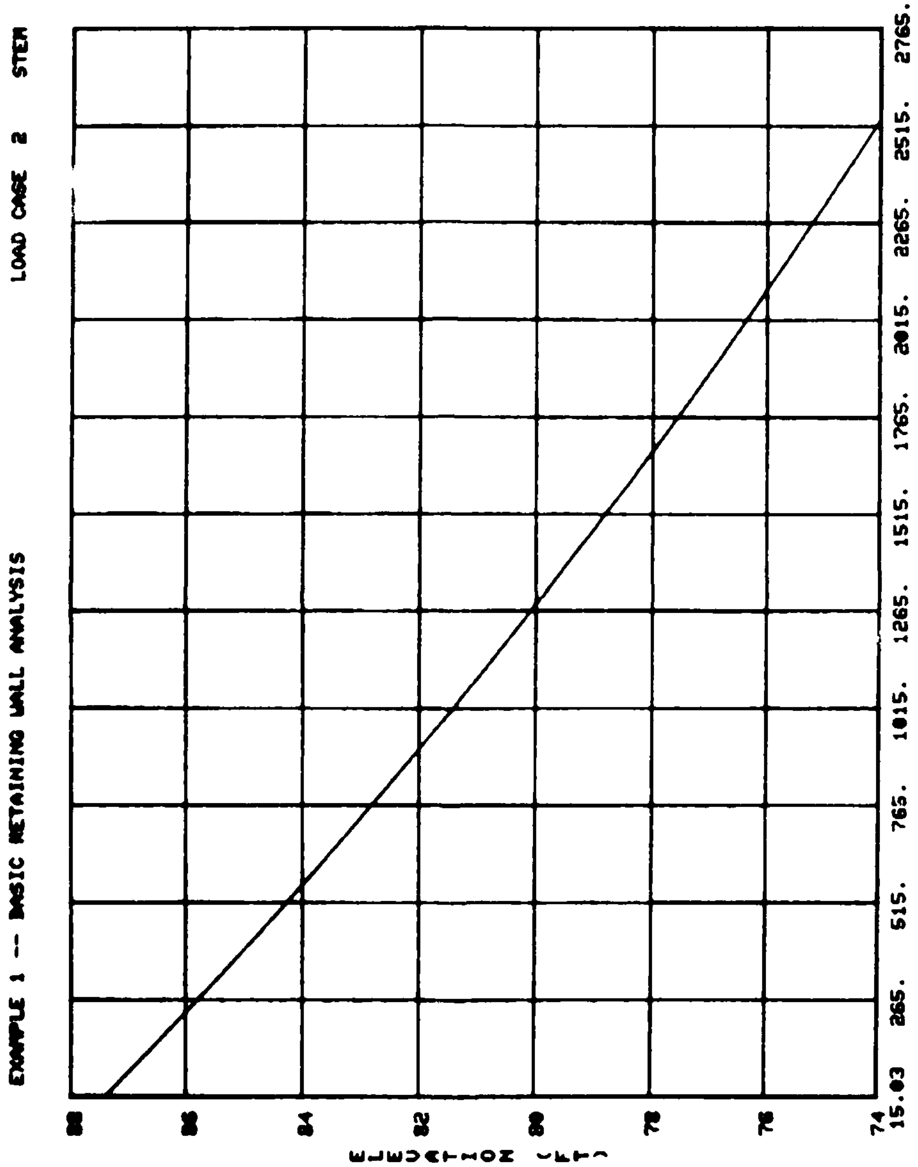
```
THE AXIAL FORCE IS CONSTANT =   1217.991 LB/FT FOR THE HEEL --- LOAD CASE  1
```

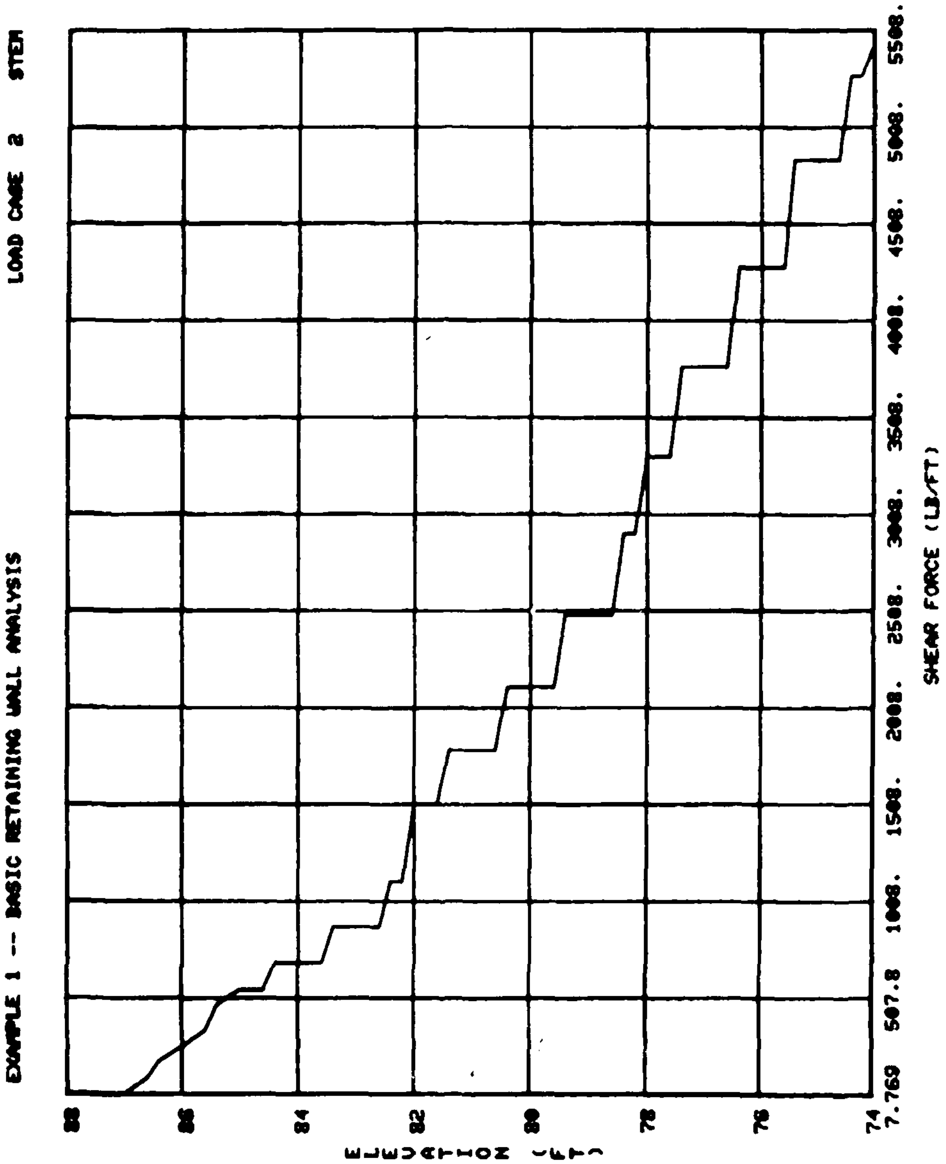

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 1
HEEL
HOR. DIST. FROM BASIC WKG. PT. (FT)
1.6
2.6
3.6
4.6
5.6
6.6
7.6
8.6
9.6
4233.
3733.
3233.
2733.
2233.
1733.
1233.
732.9
232.9
SHEAR FORCE (LB/FT)

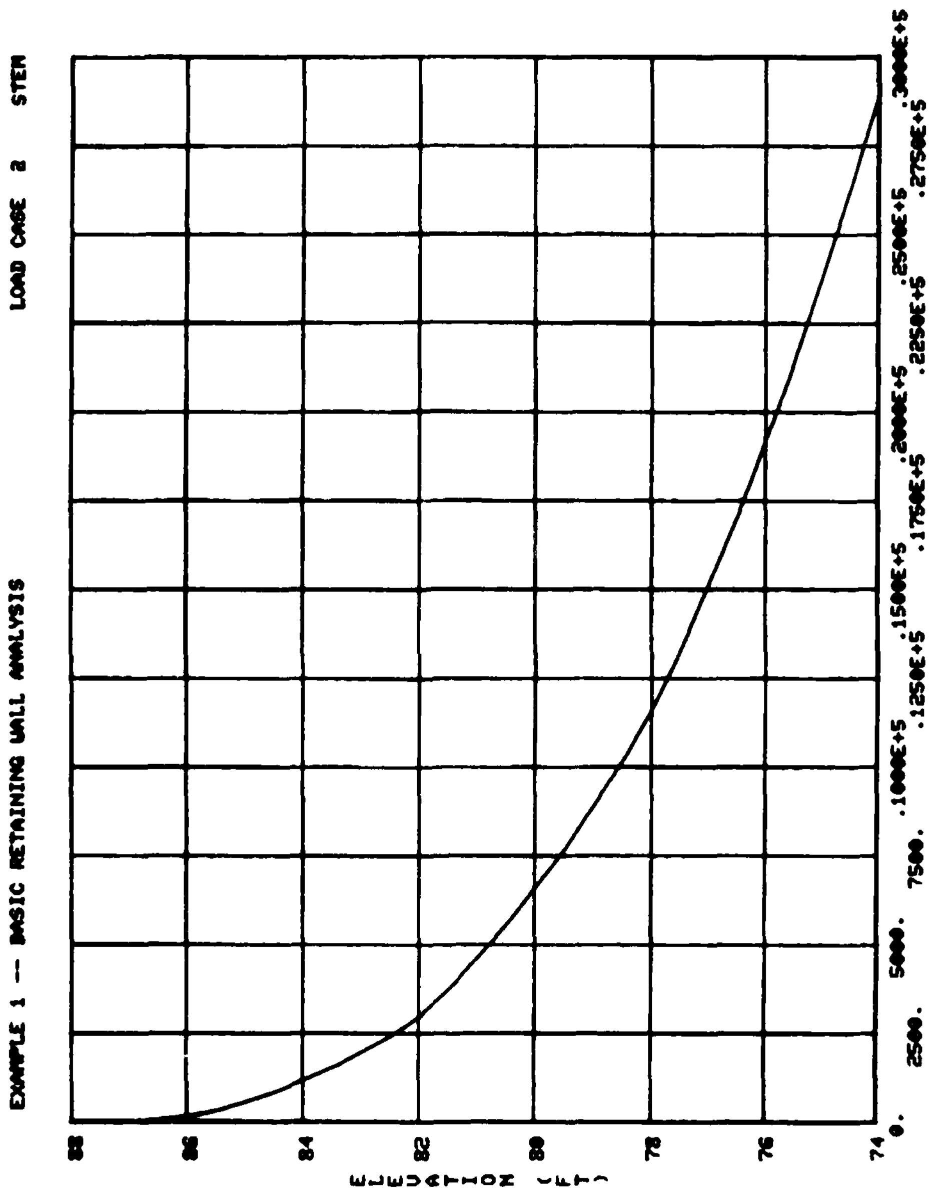

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 1
HEEL
HOR. DIST. FROM BASIC WKG. PT. (FT)
1.6
2.6
3.6
4.6
5.6
6.6
7.6
8.6
9.6
22500
20000
17500
15000
12500
10000
7500
5000
2500
0
-2500

```
ENTER 1 TO PLOT ANOTHER MEMBER
      0 TO CONTINUE
?0
ENTER 1 TO PLOT ANOTHER LOAD CASE
      0 TO CONTINUE
?1
ACTIVE LOAD CASES
------ ---- -----
                1
                2
ENTER DESIRED ACTIVE LOADCASE
?2
TYPE IN MEMBER NUMBER (1-4)
     STEM --- 1
     TOE  --- 2
     KEY  --- 3
     HEEL --- 4
?1
```

```
WHAT PLOT DO YOU DESIRE
TYPE 1 --- AXIAL FORCE
     2 --- SHEAR FORCE
     3 --- MOMENT
     4 --- ALL PLOTS
    >4 --- RETURN
?4
```


EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 2
STEM
ELEVATION (FT)
AXIAL FORCE (LB/FT)
86
84
82
80
78
76
74
15.03
265.
515.
765.
1015.
1265.
1515.
1765.
2015.
2265.
2515.
2765.

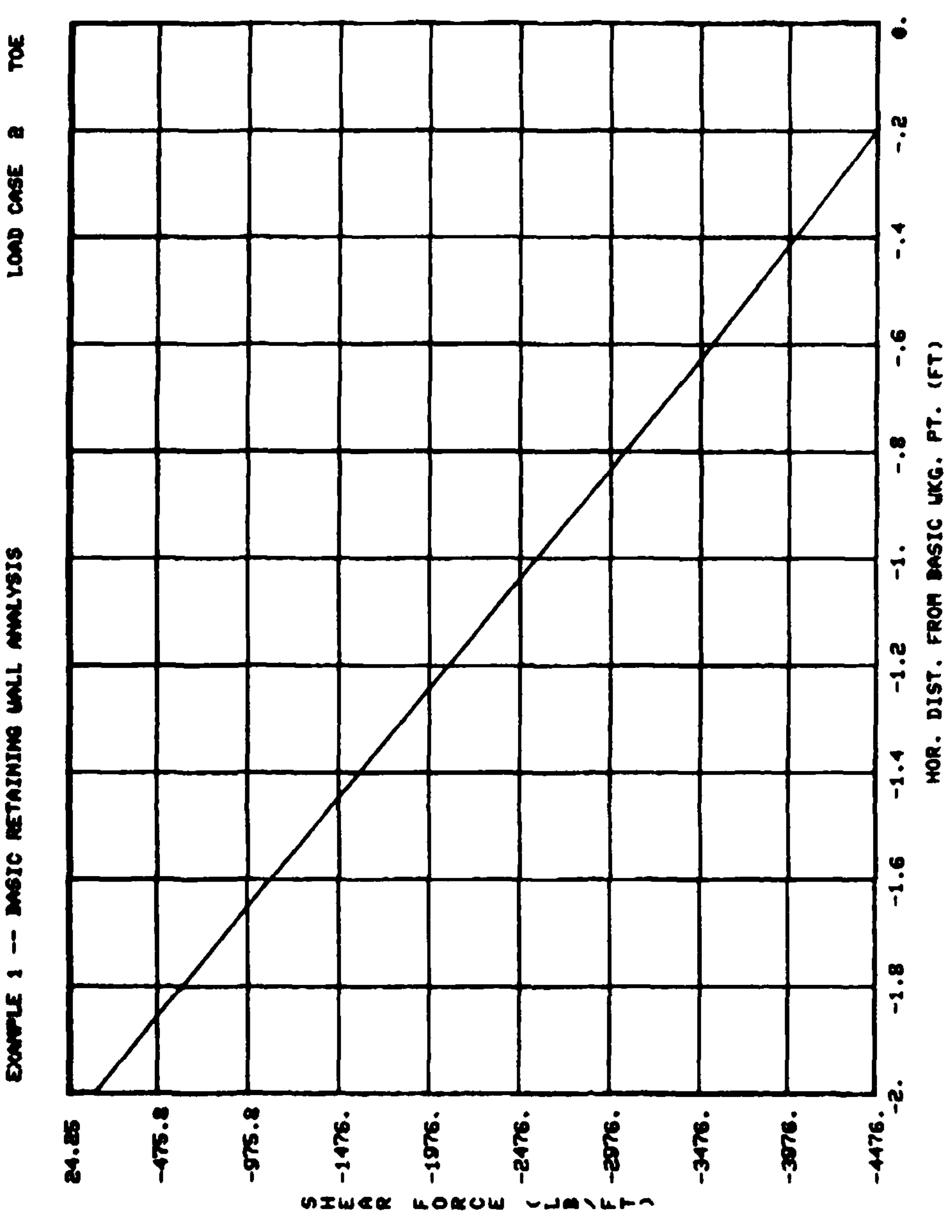

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 2
STEM
ELEVATION (FT)
88
86
84
82
80
78
76
74
7.769
507.8
1008.
1508.
2008.
2508.
3008.
3508.
4008.
4508.
5008.
5508.
SHEAR FORCE (LB/FT)



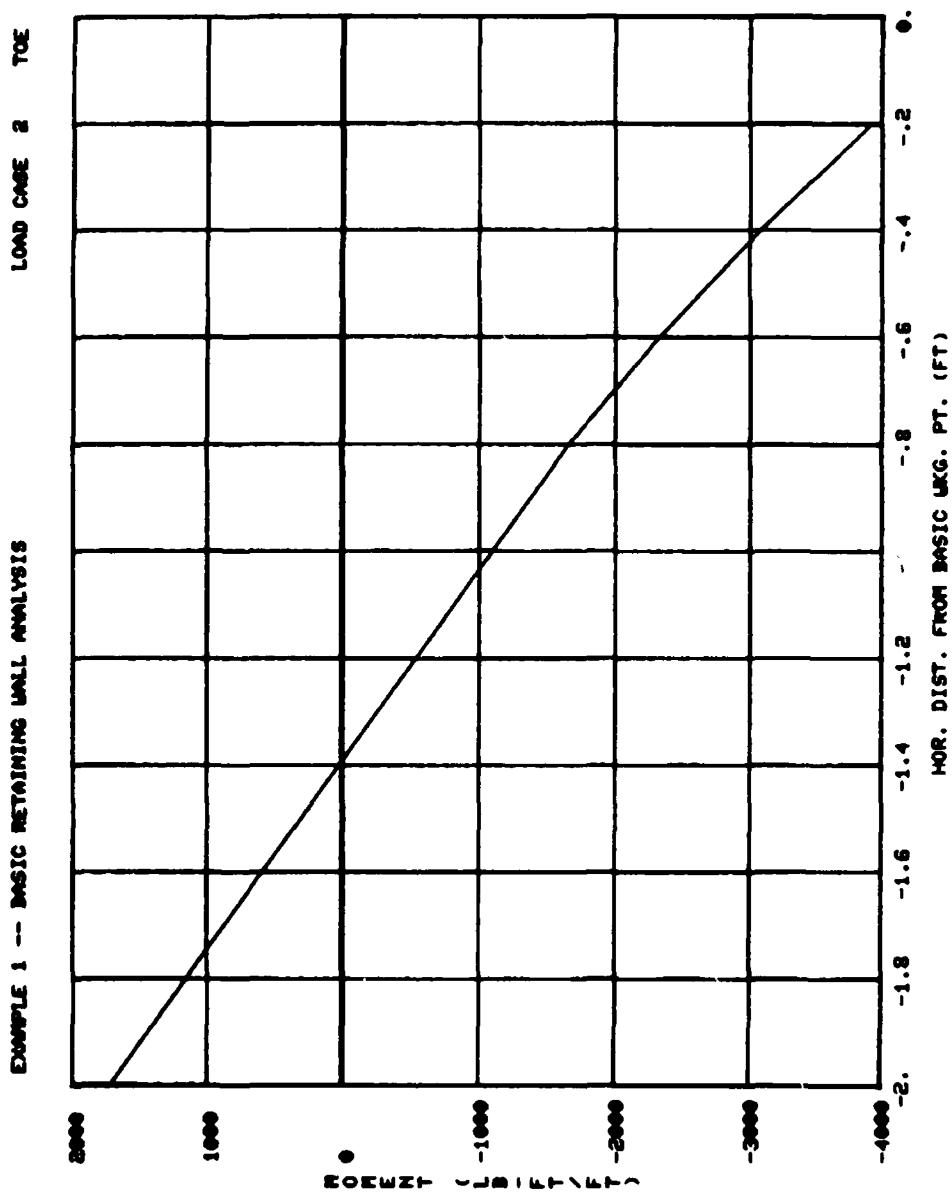
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 2 STEM
ELEVATION (FT)
88
86
84
82
80
78
76
74
MOMENT (LB-FT/FT)
0.
2500.
5000.
7500.
.1000E+5
.1250E+5
.1500E+5
.1750E+5
.2000E+5
.2250E+5
.2500E+5
.2750E+5
.3000E+5

```
ENTER 1 TO PLOT ANOTHER MEMBER
      0 TO CONTINUE
?1
TYPE IN MEMBER NUMBER (1-4)
      STEM --- 1
      TOE  --- 2
      KEY  --- 3
      HEEL --- 4
?2
```

```
THE AXIAL FORCE IS CONSTANT =    837.467 LB/FT FOR THE TOE  --- LOAD CASE  2\
```



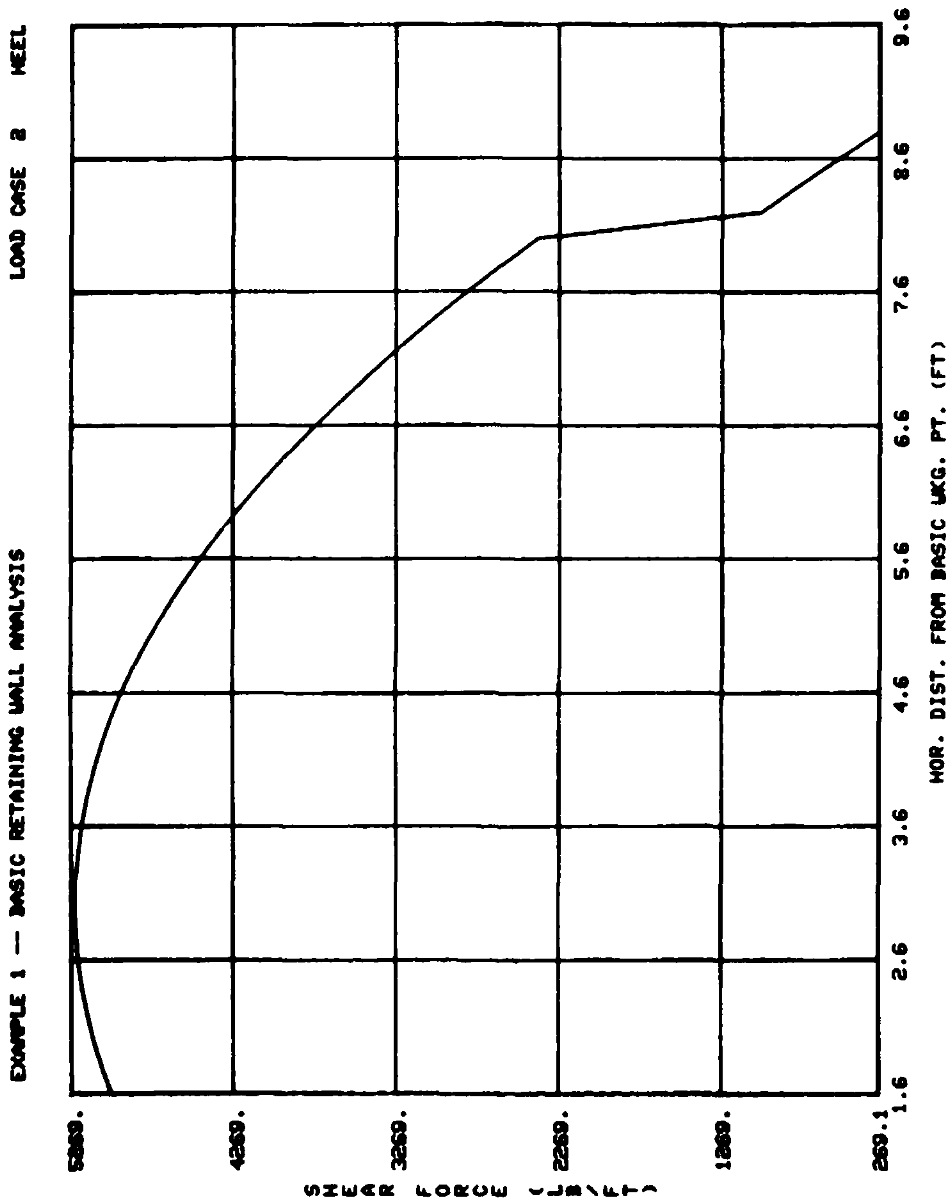
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 2
TOE
0.
-.2
-.4
-.6
-.8
-1.
-1.2
-1.4
-1.6
-1.8
-2.
HOR. DIST. FROM BASIC WKG. PT. (FT)
24.85
-475.2
-975.2
-1476.
-1976.
-2476.
-2976.
-3476.
-3976.
-4476.
SHEAR FORCE (LB/FT)

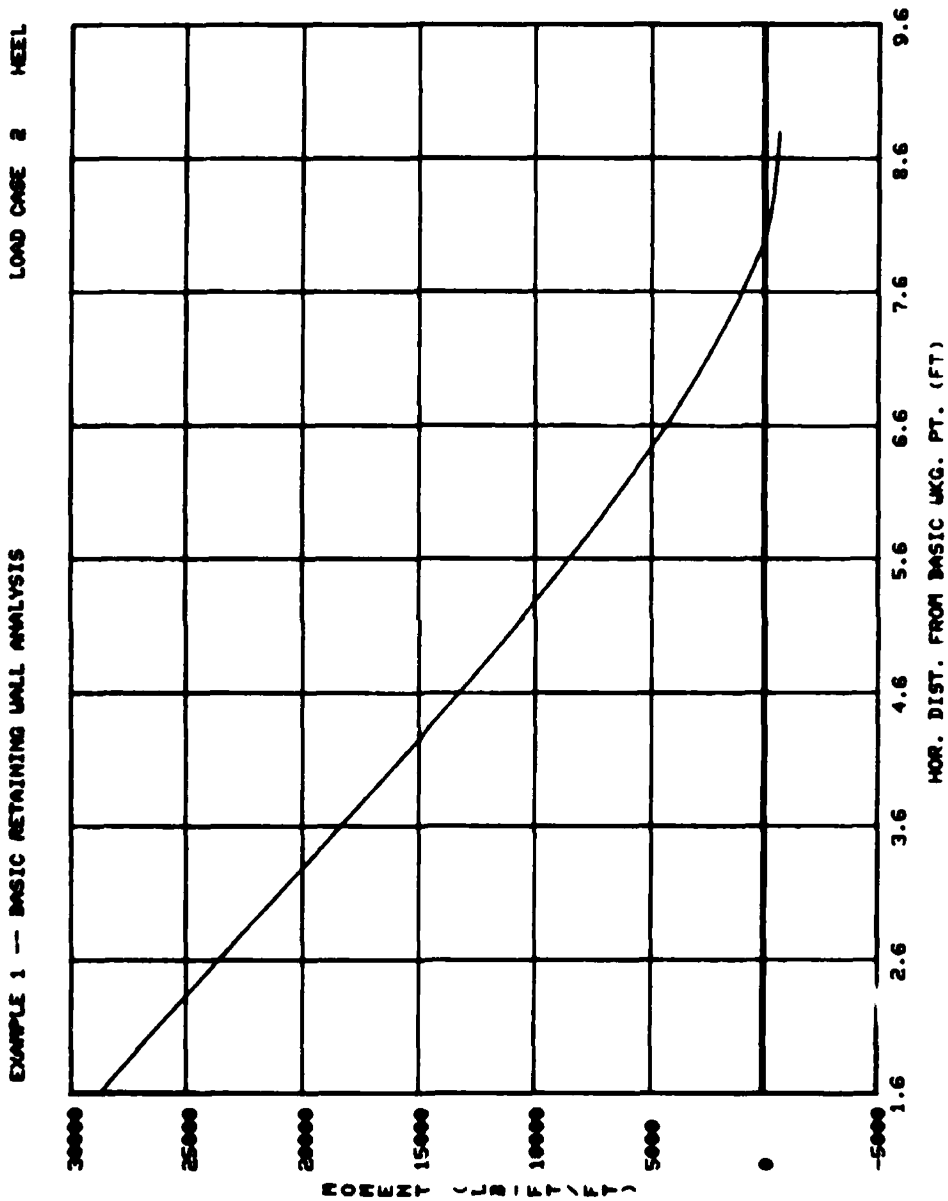

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
LOAD CASE 2 TOE
HOR. DIST. FROM BASIC WKG. PT. (FT)
-2.
-1.8
-1.6
-1.4
-1.2
-.8
-.6
-.4
-.2
0.
2000
1000
0
-1000
-2000
-3000
-4000

```
ENTER 1 TO PLOT ANOTHER MEMBER
      0 TO CONTINUE
?1
TYPE IN MEMBER NUMBER (1-4)
     STEM --- 1
     TOE  --- 2
     KEY  --- 3
     HEEL --- 4
?4
```

```
WHAT PLOT DO YOU DESIRE
TYPE 1 --- AXIAL FORCE
     2 --- SHEAR FORCE
     3 --- MOMENT
     4 --- ALL PLOTS
    >4 --- RETURN
?4
```

THE AXIAL FORCE IS CONSTANT =   473.740 LB/FT FOR THE HEEL --- LOAD CASE 2


EXAMPLE 1 — BASIC RETAINING WALL ANALYSIS
LOAD CASE 2 HEEL
HOR. DIST. FROM BASIC WKG. PT. (FT)
1.6
2.6
3.6
4.6
5.6
6.6
7.6
8.6
9.6


EXAMPLE 1 — BASIC RETAINING WALL ANALYSIS
LOAD CASE 2 HEEL
HOR. DIST. FROM BASIC WKG. PT. (FT)
1.6
2.6
3.6
4.6
5.6
6.6
7.6
8.6
9.6
30000
25000
20000
15000
10000
5000
0
-5000

```
ENTER 1 TO PLOT ANOTHER MEMBER
      0 TO CONTINUE
?0
ENTER 1 TO PLOT ANOTHER LOAD CASE
      0 TO CONTINUE
?0
ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      3 TO TERMINATE GRAPHICS
?3
$$$

$
$ UPDATE FILE RESET
$


$
$ COMMAND-DATA PHASE ENTERED
$

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?1

your update file for future restart is named KACX
stop    OK (release unneeded files)

$
```

2-4 REPORT FILE PRINTOUT:

```
RRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRR
          11:42:11 ON  9/17/80



 NOTES TO EXPLAIN SPECIAL PRINTOUT THAT MIGHT BE IN THIS FILE--

 THE VALUE "-.1234E+31" IS USED TO DENOTE AN  UNDEFINED ITEM;
 THE VALUE "-.1432E+31" MEANS THAT THE DEFAULT VALUE WAS REQUESTED.

 A "MEMORY FAULT AT ..." MESSAGE PROBABLY MEANS THAT NEEDED DATA IS UNDEFINED.

.

 END OF NOTES.

 COMMAND ENTERED:
 INIT

 *- ALL DATA RESET FOR FRESH START -*

 COMMAND ENTERED:
 R

 COMMAND ENTERED:
 N
```

```
11:42:46 ON  9/17/80

WALL DECLARED TO BE A NON-HYDRAULIC RETAINING WALL

COMMAND ENTERED:
NAME  EXAMPLE 1 --'BASIC RETAINING WALL ANALYSIS

COMMAND ENTERED:
SSHC 0  87.29  6.0

COMMAND ENTERED:
SST   0  74.0  100.0

COMMAND ENTERED:
SPE3 18.0 0.0 120.0 18.0 0.0 3000.0 4600.0 3000.0 4600.0 60.0

COMMAND ENTERED:
SPH1  0  30.0  0.0  120.0  C  0.0  C  C

COMMAND ENTERED:
SPT7  0  30.0  0.0  120.0

COMMAND ENTERED:
WLA   87.5  2.0  C  C

COMMAND ENTERED:
WLAH  11.0  11.0  12.0  0.0

COMMAND ENTERED:
WLAH  18.0  S  18.0

COMMAND ENTERED:
WLAS  12.0  0.0  18.0  0.0  0.0  C

COMMAND ENTERED:
WLAT  72.5  18.0  100.0  0.0  100.0

COMMAND ENTERED:
STLS  1  0.79  1  0.79

COMMAND ENTERED:
STLB  1  1  0.79  1  0.79

COMMAND ENTERED:
STLB 13  1  0.79  1  0.79

COMMAND ENTERED:
SCFD  2  C  1140.0  8.0

COMMAND ENTERED:
SCFH  2  400.0  82.0  400.0  78.0

COMMAND ENTERED:
SCWH  2  200.0  87.0  85.0

NOT ENOUGH VALUES ENTERED IN DATA LIST - SCWH
TRAILING VALUES SET TO "C"

COMMAND ENTERED:
UPDATE

#
# UPDATE FILE RESET
#
```

```
COMMAND ENTERED:

COMMAND ENTERED:
RUN FA




EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         11:44:49 ON  9/17/80

#
# BEGIN BASIC STABILITY DATA CHECK
#

DEFAULT VALUE OF    62.50000     USED FOR GAMAW      (LOAD CASE  1)

DEFAULT VALUE OF    150.0000     USED FOR GAMAC      (LOAD CASE  1)

DEFAULT VALUE OF    1.000000     USED FOR FSS        (LOAD CASE  1)

DEFAULT VALUE OF    2.000000     USED FOR EXW        (LOAD CASE  1)

DEFAULT VALUE OF   0.            USED FOR UCFXS3     (LOAD CASE  1)

DEFAULT VALUE OF   0.            USED FOR UCFXS4     (LOAD CASE  1)

DEFAULT VALUE OF   0.            USED FOR UCFXS5     (LOAD CASE  1)

DEFAULT VALUE OF   0.            USED FOR UCBFS1     (LOAD CASE  1)

DEFAULT VALUE OF   0.            USED FOR UCBFS2     (LOAD CASE  1)

DEFAULT VALUE OF   0.            USED FOR UCBFF7     (LOAD CASE  1)

DEFAULT VALUE OF   0.            USED FOR UCBFS7     (LOAD CASE  1)

DEFAULT VALUE OF   0.            USED FOR UCBFS6     (LOAD CASE  1)

DEFAULT VALUE OF    1.000000     USED FOR UCWS       (LOAD CASE  1)

DEFAULT VALUE OF    1.000000     USED FOR UCWB       (LOAD CASE  1)

DEFAULT VALUE OF    1.000000     USED FOR UCWK       (LOAD CASE  1)

DEFAULT VALUE OF           2     USED FOR IFWOC      (LOAD CASE  1)

DEFAULT VALUE OF           1     USED FOR IFSOM      (LOAD CASE  1)

DEFAULT VALUE OF    1.000000     USED FOR CFMA       (LOAD CASE  1)

DEFAULT VALUE OF   0.3333333     USED FOR RBMIN      (LOAD CASE  1)

DEFAULT VALUE OF           2     USED FOR KBACK      (LOAD CASE  1)

DEFAULT VALUE OF    2.000000     USED FOR FSMIN      (LOAD CASE  1)

DEFAULT VALUE OF           1     USED FOR NSLIDE     (LOAD CASE  1)

DEFAULT VALUE OF   0.            USED FOR HGSW       (LOAD CASE  1)

DEFAULT VALUE OF           2     USED FOR IFWOC      (LOAD CASE  2)
```

```
DEFAULT VALUE OF          3        USED FOR IFSCM      (LOAD CASE  2)

DEFAULT VALUE OF     1.000000      USED FOR CFMA       (LOAD CASE  2)

DEFAULT VALUE OF     0.3333333     USED FOR RRMIN      (LOAD CASE  2)

DEFAULT VALUE OF          2        USED FOR KRACK      (LOAD CASE  2)

DEFAULT VALUE OF     2.000000      USED FOR FSMIN      (LOAD CASE  2)

DEFAULT VALUE OF          3        USED FOR NSLTOE     (LOAD CASE  2)

DEFAULT VALUE OF     0.            USED FOR HGSW       (LOAD CASE  2)

DEFAULT VALUE OF     100.0000      USED FOR HSSSH      (LOAD CASE  1)

DEFAULT VALUE OF     0.            USED FOR DISSH      (LOAD CASE  1)


EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         11:44:49 ON  9/17/80


#
# BEGIN PART 2 OF STABILITY DATA CHECK
#



EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         11:44:49 ON  9/17/80



#
# BEGIN MODULE EA
#

VARIABLE HEELW CALCULATED          7.50 (BW-TW2-TSTB)
VARIABLE HSRPB CALCULATED OR DEFAULTED TO CLOSE COORDINATES,
         HSRPB =  0.444444 IN/FT,


                  COORDINATES OF CORNERS OF WALL CROSS-SECTION

         X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
         Y-COORDINATES ARE ELEVATIONS

     PT.     X          Y                     DESCRIPTION OF POINT
     --  ---------  ----------    ------------------------------------------
      1    0.         87.5000     BASIC WORKING POINT = TOE-SIDE OF STEM TOP
      2    0.         74.0000     BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
      3    0.         74.0000     BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
      4   -2.0000     74.0000     TOP OF TOEHT = AT OUTER END OF TW2
      5   -2.0000     72.5000     TOE END OF BASE = AT BTE1
     10    9.0000     72.5000     HEEL END OF BASE
     11    9.0000     74.0000     TOP OF HEELT2 = TOP OF OUTER END OF HEEL
     12    1.5000     74.0000     BOTTOM OF HEEL-SIDE FACE OF STEM
     13    1.0000     87.5000     BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
     14    1.0000     87.5000     TOP OF HEEL-SIDE FACE OF STEM
```

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
11:44:50 ON 9/17/86

*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:

BACKFILL LAYER	KA VALUE
1	0.3711

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 1
FOR CLASSIC(COULOMB) ANALYSIS IN SA (END OF HEEL)

OUTPUT OF ARRAYS H, FH, AND YH IN MODULE SA FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
88.790	7.4212	0.
87.790	44.527	0.
86.790	89.055	0.
85.790	133.58	0.
84.790	178.11	0.
83.790	222.64	0.
82.790	267.16	0.
81.790	311.69	0.
80.790	356.22	0.
79.790	400.75	0.
78.790	445.27	0.
77.790	489.80	0.
76.790	534.33	0.
75.790	578.85	0.
74.790	623.38	0.
73.790	667.91	0.
72.790	452.72	0.
72.500	104.55	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 5907.97 LBS/HORIZ FT
ACTING AT ELEVATION 77.93

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 1

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	5006.25	0.	20278.13
ACTIVE EARTH	0.	5907.97	-32080.30
SOIL+WATER	13151.94	0.	94469.53
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	18158.19	5907.97	82667.35

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
11:44:52 ON 9/17/80

*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:

BACKFILL LAYER	KA VALUE
1	0.3711

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 2
FOR CLASSIC(COULOMB) ANALYSIS IN SA (END OF HEEL)

OUTPUT OF ARRAYS H, FH, AND YH IN MODULE SA FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
88.790	7.4212	0.
87.790	44.527	0.
86.790	89.055	0.
85.790	133.58	0.
84.790	178.11	0.
83.790	222.64	0.
82.790	267.16	0.
81.790	311.69	0.
80.790	356.22	0.
79.790	400.75	0.
78.790	445.27	0.
77.790	489.80	0.
76.790	534.33	0.
75.790	578.85	0.
74.790	623.38	0.
73.790	667.91	0.
72.790	452.72	0.
72.500	104.55	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 5907.97 LBS/HORIZ FT
ACTING AT ELEVATION 77.93

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 2

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	5006.25	0.	20278.13
ACTIVE EARTH	0.	5907.97	-32080.30
SOIL+WATER	13151.94	0.	94469.53
SURCHARGES	0.	0.	0.
DIRECT LOADS	1140.00	1200.00	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	19298.19	7107.97	82667.35

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
11:44:53 ON 9/17/80

#
BEGIN THE OVERTURNING COMPUTATION
#

LOAD CASE 1

DEFAULT VALUE OF 1 USED FOR ISET(LC) (LOAD CASE 1)

DEFAULT VALUE OF 3 USED FOR NPPD(LC) (LOAD CASE 1)

RESULTANT IS WITHIN THE KERN

```
CREEP PATH DESCRIPTION FOR LOAD CASE 1

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
    9.00               72.50                   0.
    9.00               72.50                   0.
   -2.00               72.50                   0.
   -2.00               72.50                   0.

 OVERTURNING HYDRAULIC GRADIENT  =  0.


 > VALUE OF NPPD(LC)    FOUND =            3       IN S/R CHEKIT (LOAD CASE   1)

 > VALUE OF ADHS3       FOUND =    0.              IN S/R CHEKRT (LOAD CASE   1)

 > VALUE OF PHIS3       FOUND =     18.00000       IN S/R CHEKRT (LOAD CASE   1)

 > VALUE OF ADHS4       FOUND =    0.              IN S/R CHEKRT (LOAD CASE   1)

 > VALUE OF ADHS5       FOUND =    0.              IN S/R CHEKRT (LOAD CASE   1)

 > VALUE OF PHIS4       FOUND =    0.              IN S/R CHEKRT (LOAD CASE   1)

 > VALUE OF PHIS5       FOUND =    0.              IN S/R CHEKRT (LOAD CASE   1)


   AT BASE-SOIL INTERFACE:
     WEIGHTED AVERAGE COEFFICIENT OF FRICTION =          0.32
     WEIGHTED AVERAGE ADHESION                =          0.   (LBS/SQ.FT)
     EFFECTIVE BASE WIDTH                     =         11.00 (FEET)
     EFFECTIVE LENGTH ALONG BASE SLOPE        =         11.00 (FEET)
     NORMAL FORCE ACTING ON BASE              =      18158.19 (LBS/SLICE)
     FRICTIONAL FORCE                         =       5899.95 (LBS/SLICE)
     FORCE DUE TO ADHESION                    =          0.   (LBS/SLICE)
     TOTAL FORCE ALONG BASE                   =       5899.95 (LBS/SLICE)
     HORIZONTAL COMPONENT OF TOTAL FORCE      =       5899.95 (LBS/SLICE)



 PASSIVE EARTH PRESSURES FOR LOAD CASE  1

 NPPD                                 =          3
 ELEVATION OF TOP OF SOIL             =    74.020      (FT)
 PRESSURE AT TOP OF SOIL              =   0.           (LBS/SQ.FT)
 ELEVATION OF LOWEST POINT ON WALL    =    72.500      (FT)
 PRESSURE AT LOWEST POINT ON WALL     =   -10.553      (LBS/SQ.FT)
 PASSIVE EARTH FORCE                  =   -8.0201      (LBS/SLICE)
 PASSIVE EARTH MOMENT                 =    4.0635      (FT-LBS/SLICE)


 DISTANCE FROM THE TOE TO THE RESULTANT          =  4.55 (FT)
 VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE   =         0.    (LBS/SLICE)
 HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES   =         0.    (LBS/SLICE)
 MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES  =         0.    (FT-LBS/SLICE)


THE RESULTANT RATIO =      0.4139, FOR LOAD CASE  1
```

LOAD CASE 2

DEFAULT VALUE OF 1 USED FOR ISET(LC) (LOAD CASE 2)

DEFAULT VALUE OF 3 USED FOR NPPD(LC) (LOAD CASE 2)

RESULTANT IS WITHIN THE KERN

CREEP PATH DESCRIPTION FOR LOAD CASE 2

X-COORDINATES	Y-COORDINATES	HYDROSTATIC PRESSURE
9.00	72.50	0.
9.00	72.50	0.
-2.00	72.50	0.
-2.00	72.50	0.

OVERTURNING HYDRAULIC GRADIENT = 0.

> VALUE OF NPPD(LC) FOUND = 3 IN S/R CHEKIT (LOAD CASE 2)

> VALUE OF ADHS3 FOUND = 0. IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF PHIS3 FOUND = 18.00000 IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF ADHS4 FOUND = 0. IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF ADHS5 FOUND = 0. IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF PHIS4 FOUND = 0. IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF PHIS5 FOUND = 0. IN S/R CHEKRT (LOAD CASE 2)

AT BASE-SOIL INTERFACE:

WEIGHTED AVERAGE COEFFICIENT OF FRICTION	=	0.32	
WEIGHTED AVERAGE ADHESION	=	0.	(LBS/SQ.FT)
EFFECTIVE BASE WIDTH	=	11.00	(FEET)
EFFECTIVE LENGTH ALONG BASE SLOPE	=	11.00	(FEET)
NORMAL FORCE ACTING ON BASE	=	19298.19	(LBS/SLICE)
FRICTIONAL FORCE	=	6270.36	(LBS/SLICE)
FORCE DUE TO ADHESION	=	0.	(LBS/SLICE)
TOTAL FORCE ALONG BASE	=	6270.36	(LBS/SLICE)
HORIZONTAL COMPONENT OF TOTAL FORCE	=	6270.36	(LBS/SLICE)

PASSIVE EARTH PRESSURES FOR LOAD CASE 2

NPPD	=	3	
ELEVATION OF TOP OF SOIL	=	74.020	(FT)
PRESSURE AT TOP OF SOIL	=	0.	(LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL	=	72.500	(FT)
PRESSURE AT LOWEST POINT ON WALL	=	-1102.1	(LBS/SQ.FT)
PASSIVE EARTH FORCE	=	-837.61	(LBS/SLICE)
PASSIVE EARTH MOMENT	=	424.39	(FT-LBS/SLICE)

```
DISTANCE FROM THE TOE TO THE RESULTANT          =  4.31 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE   =          0.    (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES   =          0.    (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES  =          0.    (FT-LBS/SLICE)


THE RESULTANT RATIO =       0.3914, FOR LOAD CASE  2
```

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         11:44:53 ON  9/17/80
```

```
#
# BEGIN SLIDING COMPUTATION
#
```

```
FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.07, FOR LOAD CASE  1
BY SHEAR FRICTION METHOD

    SUM OF DRIVING FORCES   =  5907.973 (LBS/SLICE)
    SUM OF RESISTING FORCES =  6304.766 (LBS/SLICE)

    PASSIVE EARTH FORCE                     =     404.81 (LBS/SLICE)
    ACTIVE EARTH FORCE                      =    5907.97 (LBS/SLICE)
    UPLIFT FORCE                            =       0.   (LBS/SLICE)
    SUMMATION OF HORIZONTAL WATER FORCES    =       0.   (LBS/SLICE)

     FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
         X            Y
       -2.00        72.50
        9.00        72.50

FINAL FACTOR OF SAFETY AGAINST SLIDING =      0.94, FOR LOAD CASE  2
BY SHEAR FRICTION METHOD

    SUM OF DRIVING FORCES   =  7107.973 (LBS/SLICE)
    SUM OF RESISTING FORCES =  6675.174 (LBS/SLICE)

    PASSIVE EARTH FORCE                     =     404.81 (LBS/SLICE)
    ACTIVE EARTH FORCE                      =    7107.97 (LBS/SLICE)
    UPLIFT FORCE                            =       0.   (LBS/SLICE)
    SUMMATION OF HORIZONTAL WATER FORCES    =       0.   (LBS/SLICE)

     FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
         X            Y
       -2.00        72.50
        9.00        72.50
```

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         11:44:55 ON  9/17/80


#
#  BEGIN ALLOWABLE BEARING CAPACITY COMPUTATIONS
#


THE BASE LIES IN SOIL 3


 FOR LOAD CASE  1,

 FOR THE BASE COORDINATES  X= -2.00  Y= 72.50, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE      =    3867.13 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE          =   2503.57 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X=  9.00  Y= 72.50, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE      =    3867.13 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE          =    797.92 (LBS/SQ.FT)

 THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE,  1


 FOR LOAD CASE  2,

 FOR THE BASE COORDINATES  X= -2.00  Y= 72.50, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE      =    3867.13 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE          =   2897.27 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X=  9.00  Y= 72.50, THE ABSOLUTE VALUE OF:
 THE  ALLOWABLE BEARING PRESSURE      =    3867.13 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE          =    611.49 (LBS/SQ.FT)

 THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE,  2
```

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         11:44:55 ON  9/17/80


#
# BEGIN COST ANALYSIS
#
```

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	0.	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	0.	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	16.88	1.00	16.88
BASE	16.50	1.00	16.50
KEY	0.	1.00	0.

TOTAL CONCRETE VOLUME = 33.38 (CU FT / LF), FOR LOAD CASE 1

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	0.	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	0.	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	16.88	1.00	16.88
BASE	16.50	1.00	16.50
KEY	0.	1.00	0.

TOTAL CONCRETE VOLUME = 33.38 (CU FT / LF), FOR LOAD CASE 2

#
BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE 1
#

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF 72.50 IS 0.

#
BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE 2
#

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF 72.50 IS 0.

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
11:44:57 ON 9/17/80

\#
\# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
\#

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:

BACKFILL LAYER	KA VALUE
1	0.3879

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 1
FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
87.457	7.7689	0.
86.457	46.614	0.
85.457	93.227	0.
84.457	139.84	0.
83.457	186.45	0.
82.457	233.07	0.
81.457	279.68	0.
80.457	326.30	0.
79.457	372.91	0.
78.457	419.52	0.
77.457	466.14	0.
76.457	512.75	0.
75.457	559.36	0.
74.457	435.19	0.
74.000	141.59	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 4220.41 LBS/HORIZ FT
ACTING AT ELEVATION 78.49

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
        11:44:58 ON  9/17/80


#
# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#


 COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
    BACKFILL LAYER           KA VALUE
    ..............           ........
          1                   0.3879

        HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  2
        FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

        OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

          ELEVATION  INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                         STATIC FORCE          EARTHQUAKE FORCE
            (FT)          (LBS/FT)                (LBS/FT)
          ---------  ----------------------  ----------------------
         87.457            7.7689                    0.
         86.457           46.614                     0.
         85.457           93.227                     0.
         84.457          139.84                      0.
         83.457          186.45                      0.
         82.457          233.07                      0.
         81.457          279.68                      0.
         80.457          326.30                      0.
         79.457          372.91                      0.
         78.457          419.52                      0.
         77.457          466.14                      0.
         76.457          512.75                      0.
         75.457          559.36                      0.
         74.457          435.19                      0.
         74.000          141.59                      0.

        FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

        RESULTANT HORIZONTAL STATIC ACTIVE FORCE =    4220.41 LBS/HORIZ FT
        ACTING AT ELEVATION    78.49

        RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
        DUE TO EARTHQUAKE =        0.   LBS/HORIZ FT
        ACTING AT ELEVATION      0.


#
# EXIT MODULE EA
#


#
# UPDATE FILE RESET
#

COMMAND ENTERED:
RUN WA
```

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
         11:45:47 ON  9/17/80

#
# BEGIN MODULE WA
#

DEFAULT VALUE OF    0.             USED FOR BASER       (LOAD CASE  1)

DEFAULT VALUE OF            0      USED FOR KFLAG       (LOAD CASE  1)

DEFAULT VALUE OF    0.             USED FOR DKEY        (LOAD CASE  1)

HEELW  CALCULATED TO BE      7.5000

STR    CALCULATED TO BE     0.18182

YOUR HEELT1 VALUE OF    18.00      INCHES SET THE TOP
OF THE HEEL AT THE STEM (   74.0000) SO CLOSE TO THE TOP
OF THE TOE AT THE STEM THAT BOTH WERE SET TO THE SAME VALUE
OF     74.0000 FEET.

SLOPE OF TOP OF HEEL SLAB = 100.00 H : 1 V (100.0:1 = LEVEL)


                   COORDINATES OF CORNERS OF WALL CROSS-SECTION

         X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
         Y-COORDINATES ARE ELEVATIONS
```

PT.	X	Y	DESCRIPTION OF POINT
1	0.	87.5000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	0.	74.0000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	0.	74.0000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-2.0000	74.0000	TOP OF TOEHT = AT OUTER END OF TW2
5	-2.0000	72.5000	TOE END OF BASE = AT BTE1
10	9.0000	72.5000	HEEL END OF BASE
11	9.0000	74.0000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	1.5000	74.0000	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.0000	87.5000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.0000	87.5000	TOP OF HEEL-SIDE FACE OF STEM
15	8.5000	72.5000	BOTTOM OF CUTOFF WALL UNDER KEY

```
WITH BASE RADIUS ("BASER", 0.0 FOR RECTANGULAR) =       0.    FEET,
TOE END OF BASE UNIT WIDTH =    1.0000 FT. AND
HEEL END OF BASE UNIT WIDTH =   1.0000 FT.
(BASIC WORKING POINT IS 1.0 FT. WIDE).


WALL DATA LISTS:

WLA      ETS              TW2              STR             HEELW
     87.50000         2.000000        0.1818182        7.500000

WLAB     BW               BS                               BASER (LIST=WLBR)
     11.00000         0.                              0.

WLAH   HEELT2          HEELW            HEELT1
     18.00000         7.500000         18.00000

WLAK   KFLAG              DKEY             WKEY            BKTE
         0            0.               0.              100.0000
```

```
WLAS   TSTT             TSB              TSTB            HSTPH           HSTPH
     12.00000       0.                18.00000       0.               0.
      HSHPH
    0.4444444

WLAT   BTE1            TOEHT            TS2             TW1              TS1
     72.50000       18.00000        100.0000        0.              100.0000

----  TMINB           TMINS
   -0.12340000E 31 -0.12340000E 31


LOWEST CONCRETE =       72.50 FT., AT HEEL END OF BASE
COMPARED WITH THE PREVIOUS LOW OF  72.500000     FT.

  ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE   1 ----------

EH TOP CALCULATED TO BE      72.499
FOR LOAD CASE  1

> NPPD   IS          3

  ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE   2 ----------

EH TOP CALCULATED TO BE      72.499
FOR LOAD CASE  2

> NPPD   IS          3

  --------------- END OF PRESSURE DATA VERIFICATION ---------------

DEFAULT VALUE OF    3000.000      USED FOR   FPCON     (LOAD CASE  1)

DEFAULT VALUE OF   0.29000000E 08 USED FOR    ESTL     (LOAD CASE  1)

DEFAULT VALUE OF    9.190000      USED FOR   RATION    (LOAD CASE  1)

DEFAULT VALUE OF   0.4500000      USED FOR   RATIOF    (LOAD CASE  1)

DEFAULT VALUE OF    20000.00      USED FOR   FSTLMX    (LOAD CASE  1)

DEFAULT VALUE OF           0      USED FOR    IFDR     (LOAD CASE  1)

DEFAULT VALUE OF    2.500000      USED FOR   COVHS     (LOAD CASE  1)

DEFAULT VALUE OF    2.500000      USED FOR   COVTS     (LOAD CASE  1)

DEFAULT VALUE OF    2.500000      USED FOR   COVTB     (LOAD CASE  1)

DEFAULT VALUE OF    3.500000      USED FOR   CO.       (LOAD CASE  1)

DEFAULT VALUE OF    2.370000      USED FOR   [illegible]     (LOAD CASE  1)

COMBINED PASSIVE PRESSURE VALUE OF  -10.55[illegible]3     USED FOR LOAD CASE  1

COMBINED PASSIVE PRESSURE VALUE OF  -1102.120     USED FOR LOAD CASE  2
```

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
11:47: 6 ON 9/17/80

\#
\# BEGIN STRESS ANALYSIS
\#

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
11:47:27 ON 9/17/80

\#
\# BEGIN STEM STRESS ANALYSIS
\#

SHEAR AT A DISTANCE D ABOVE THE BASE--

---------------- SECTION PROPERTIES AT ELEVATION 75.17 ----------------

MOM. SIGN	COMP. FACE WIDTH, IN.	OVERALL DEPTH IN.	EFFECTIVE DEPTH, IN.	REINFORCING AREA, SQ IN	TENSION FACE	K	J
+	12.00	17.48	14.98	0.79	HEEL		
-	12.00	17.48	14.98	0.79	TOE		

--- SHEAR ANALYSIS AT ELEVATION 75.17 (+ V FROM TOP PUSHED TOWARD TOE) ---

LOAD CASE	V LB / SLICE	N (COMP +) LB / SLICE	M LB-FT/SLICE	UNIT SHEAR STRESS PSI	ALLOWABLE UNIT STRESS	ACI318-77 PROVISION
1	3643.6	2272.5	14726.	20.267	60.641	8.7.4.5
2	4843.6	2272.5	22926.	26.942	60.641	8.7.4.5

MOMENT AT THE BASE--

---------------- SECTION PROPERTIES AT ELEVATION 74.00 ----------------

MOM. SIGN	COMP. FACE WIDTH, IN.	OVERALL DEPTH IN.	EFFECTIVE DEPTH, IN.	REINFORCING AREA, SQ IN	TENSION FACE	K	J
+	12.00	18.00	15.50	0.79	HEEL	0.243	0.919
-	12.00	18.00	15.50	0.79	TOE	0.243	0.919

FLEXURE ANALYSIS AT ELEVATION 74.00 (+ M = TENSION AT HEEL)

LOAD CASE	N (COMP=+) LB / SLICE	M LB-FT/SLICE	FC PSI	FS PSI
1	2531.	19227.	768.	18762.
2	2531.	28827.	1125.	29000.

SHEAR IMMEDIATELY BELOW PHI--

---------------- SECTION PROPERTIES AT ELEVATION 82.00 ----------------

MOM. SIGN	COMP. FACE WIDTH, IN.	OVERALL DEPTH IN.	EFFECTIVE DEPTH, IN.	REINFORCING AREA, SQ IN	TENSION FACE	K	J
+	12.00	14.44	11.94	0.79	HEEL		
-	12.00	14.44	11.94	0.79	TOE		

--- SHEAR ANALYSIS AT ELEVATION 82.00 (+ V FROM TOP PUSHED TOWARD TOE) ---

LOAD CASE	V LB / SLICE	N (COMP +) LB / SLICE	M LB-FT/SLICE	UNIT SHEAR STRESS PSI	ALLOWABLE UNIT STRESS	ACI318-77 PROVISION
2	1507.0	909.05	2939.2	10.514	60.439	8.7.4.5

SHEAR IMMEDIATELY BELOW PH2--

---------------- SECTION PROPERTIES AT ELEVATION 78.00 ---------------

MOM. SIGN	COMP. FACE WIDTH, IN.	OVERALL DEPTH IN.	EFFECTIVE DEPTH, IN.	REINFORCING AREA, SQ IN	TENSION FACE	K	J
+	12.00	16.22	13.72	0.79	HEEL		
-	12.00	16.22	13.72	0.79	TOE		

--- SHEAR ANALYSIS AT ELEVATION 78.00 (+ V FROM TOP PUSHED TOWARD TOE) ---

LOAD CASE	V LB / SLICE	N (COMP +) LB / SLICE	M LB-FT/SLICE	UNIT SHEAR STRESS PSI	ALLOWABLE UNIT STRESS	ACI318-77 PROVISION
2	3305.4	1675.7	11566.	20.073	60.561	8.7.4.5

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
11:50:39 ON 9/17/80

#
BEGIN TOE STRESS ANALYSIS
#

SHEAR AT A DISTANCE D FROM THE STEM--
---> ANALYSIS WITHIN 1-FOOT OF END OF TOE IS MEANINGLESS <---

MOMENT AT THE STEM (POINT 2)--

----- SECTION PROPERTIES AT X = -0.001 (1.999 FEET FROM END OF TOE) -----

MOM. SIGN	COMP. FACE WIDTH, IN.	OVERALL DEPTH IN.	EFFECTIVE DEPTH, IN.	REINFORCING AREA, SQ IN	TENSION FACE	K	J
+	12.00	18.00	15.50	0.79	TOP	0.243	0.919
-	12.00	18.00	14.50	0.79	BOTT	0.250	0.917

FLEXURE ANALYSIS AT X = -0.001 (1.999 FROM END OF TOE) (+ M = TENSION IN TOP)

LOAD CASE	N (COMP=+) LB / SLICE	M LB-FT/SLICE	FC PSI	FS PSI
1	8.	-4344.	180.	4959.
2	837.	-4859.	217.	4931.

SHEAR AND MOMENT AT X = -0.001

----- SECTION PROPERTIES AT X = -0.001 (1.999 FEET FROM END OF TOE) -----

MOM. SIGN	COMP. FACE WIDTH, IN.	OVERALL DEPTH IN.	EFFECTIVE DEPTH, IN.	REINFORCING AREA, SQ IN	TENSION FACE	K	J
+	12.00	18.00	15.50	0.79	TOP	0.243	0.919
-	12.00	18.00	14.50	0.79	BOTT	0.250	0.917

```
--- SHEAR ANALYSIS AT X = -0.001 ( 1.999 FROM END OF TOE) (+ V = END DOWN) ---
LOAD       V          N (COMP +)        M          UNIT SHEAR   ALLOWABLE  ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE  STRESS  PSI  UNIT STRESS PROVISION
----  ----------    ----------   -----------  -----------  ----------- ---------
 1    -4245.1        8.0187       -4344.2       24.397        60.251    8.7.4.5
 2    -4926.7        837.47       -4858.6       28.314        60.390    8.7.4.5

FLEXURE ANALYSIS AT X = -0.001 ( 1.999 FROM END OF TOE) (+ M = TENSION IN TOP)
LOAD  N (COMP=+)        M          FC     FS
CASE  LB / SLICE  LB-FT/SLICE    PSI    PSI
----  ----------  -----------  -----  ------
 1          8.        -4344.    180.   4959.
 2        837.        -4859.    217.   4931.




EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
        11:54:39 ON  9/17/80


#
# BEGIN HEEL STRESS ANALYSIS
#


SHEAR AND MOMENT AT THE STEM--


----- SECTION PROPERTIES AT X =  1.501  ( 7.499 FEET FROM END OF HEEL) ----
MOM.  COMP. FACE   OVERALL    EFFECTIVE    REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH. IN.   AREA, SQ IN    FACE      K       J
----  ----------  ---------  ----------  -----------  -------  -----  -----
 +       12.00      18.00       15.50        0.79       TOP   0.243  0.919
 -       12.00      18.00       14.50        0.79       BOTT  0.250  0.917

--- SHEAR ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+V = END DOWN) ---
LOAD       V          N (COMP +)        M          UNIT SHEAR   ALLOWABLE  ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE  STRESS  PSI  UNIT STRESS PROVISION
----  ----------    ----------   -----------  -----------  ----------- ---------
 1     3940.7        1218.0        20848.       21.187        60.453    8.7.4.5
 2     4995.8        473.74        29234.       26.859        60.329    8.7.4.5

FLEXURE ANALYSIS AT X =  1.501 ( 7.499 FROM END OF HEEL) (+M = TENSION IN TOP)
LOAD  N (COMP=+)        M          FC     FS
CASE  LB / SLICE  LB-FT/SLICE    PSI    PSI
----  ----------  -----------  -----  ------
 1       1218.        20848.    802.  21394.
 2        474.        29234.   1099.  30849.

#
# MODULE WA COMPLETE
#

#
# UPDATE FILE RESET
#

COMMAND ENTERED:
END
```

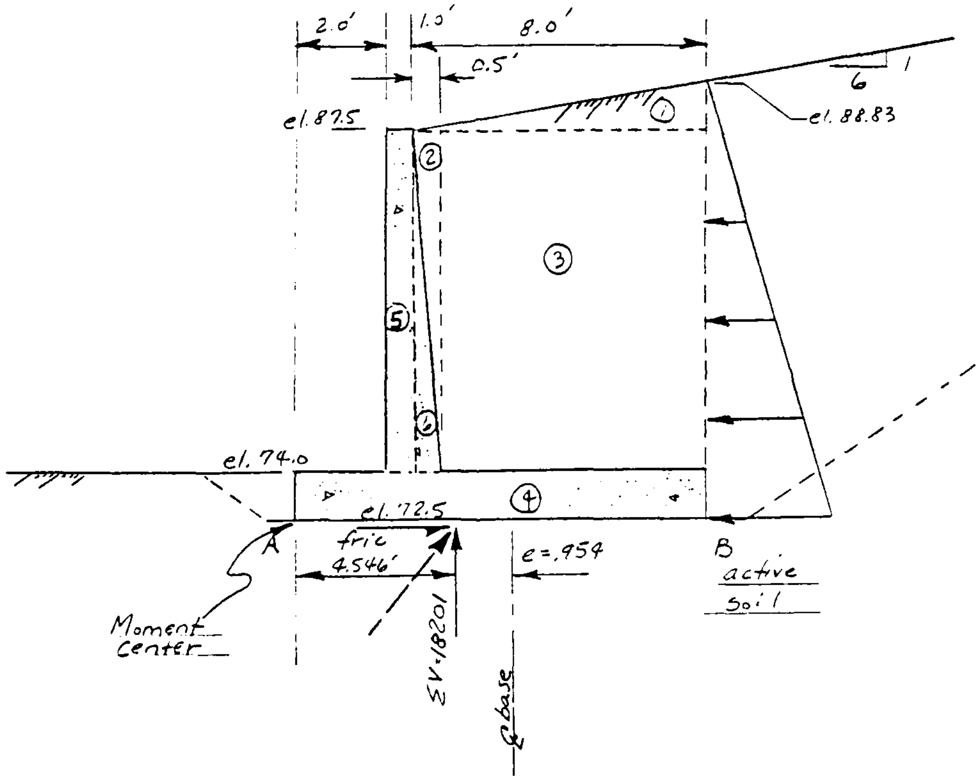
2-5 HAND CALCULATIONS. Notice the slight difference in finished grade soil surface elevation between the program (87.46 ft*) and the hand calculations (87.5 ft). This will cause a difference of about 0.5 percent in active earth force.

Design Data: $\gamma = 120$ #/cu. ft.

ϕ (backfill) = 30°

ϕ (base) = 18° (unrealistic but used for exp.)

C (base) = 0 psf

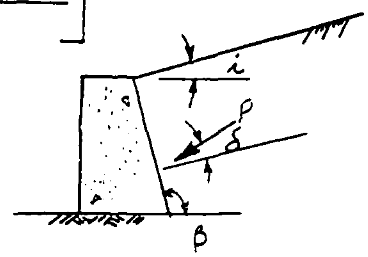


note: neglect any passive resistance

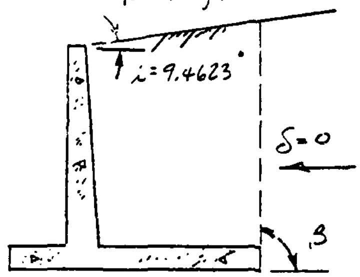
* A table of factors for converting inch-pound units of measurement to metric (SI) units is presented on page vi.

Compute horizontal earth pressures
(use Coulomb method)

$$K_a = \left[\frac{\csc\beta \ \sin(\beta-\phi)}{\sqrt{\sin(\beta+\delta)} + \sqrt{\frac{\sin(\phi+\delta)\sin(\phi-i)}{\sin(\beta-i)}}} \right]^2$$



In our problem $\beta = 90°$; $i = 9.4623°$



$\csc = 1/\sin$

$$K_a = \left[\frac{\csc 90° \ \sin(90°-30°)}{\sqrt{\sin(90°+0)} + \sqrt{\frac{\sin(30°+0)\sin(30°-9.4623)}{\sin(90°-9.4623)}}} \right]^2$$

$$K_a = \left[\frac{(1)\ (.8660)}{\sqrt{1} + \sqrt{\frac{(.5)(.3508)}{.9864}}} \right]^2 = \left[\frac{.8660}{1+.4217} \right]^2 = .6091^2$$

$$\boxed{K_a = .3710}$$

Since the backfill is cohesionless the pressure at any depth H can be expressed as:

$$p = \gamma H K_a$$

p_1 = pressure at elev. 72.5

$$p_1 = (120)(88.83 - 72.5)(.371)$$
$$p_1 = 727.0 \text{ psf}$$

<u>Compute total force due to active soil</u>

$$P_a = (1/2)(727.0)(88.83 - 72.5)$$
$P_a = 5936$ lbs. acts at $1/3\ H$

∴ acts at elev. 77.94

<u>Sum Moments about point A</u>

Item	Factors	Force vert ↓+	Force HOR ←+	Lever	Moment (+)
Soil 1	(.5)(8.0)(1.333)(120.)	+639.8		8.333	+5332.
Soil 2	(.5)(.5)(13.5)(120.)	+405.0		3.333	+1350.
Soil 3	(7.5)(13.5)(120.)	+12150.		7.25	+88088
Conc 4	(1.5)(11.0)(150)	+2475.		5.5	+13613
Conc 5	(1.0)(13.5)(150)	+2025.		2.5	+5063
Conc 6	(.5)(13.5)(.5)(150)	+506.3		3.167	+1603
P_a			+5936	5.443	-32310
fric			-5936	0.0	0
		18201		4.546	82739

Compute resultant ratio

$$r = \frac{4.546}{11.0} = .413 \quad \text{O.K.} < .333$$

Compute foundation pressures

$$\sigma = \frac{\Sigma V}{A} \pm \frac{\Sigma V(e)(c)}{I}$$

$$I = \frac{bh^3}{12} = \frac{(1.0)(11.0)^3}{12} = 110.9 \text{ ft}^4$$

$$e = .954$$

$$\sigma_A = \frac{18201}{11.0} + \frac{(18201)(.954)(5.5)}{110.9}$$

$$\boxed{\begin{aligned} \sigma_A &= 1654 + 861 = 2515 \text{ psf} \\ \sigma_B &= 1654 - 861 = 793 \text{ psf} \end{aligned}}$$

Check sliding S.F. (shear fric. method)
(see fig. 3, 4, 5)

$$S.F. = \frac{R.F.}{D.F.} = \frac{R + P_p}{\Sigma H}$$

$R = \Sigma V \tan\phi + CA$

$P_p = \frac{1}{2}\gamma H^2 \tan^2(45 + \phi/2) + 2H \tan(45 + \phi/2)\, c$

(Coulomb eq. with $i = 0, \delta = 0$, cohesive soil)

Compute RF

$R.F. = \Sigma V \tan\phi + 0 + \frac{1}{2}\gamma H^2 \tan^2(45 + \phi/2) + 0$

$R.F. = 18201 (\tan 18°) + (\frac{1}{2})(120)(1.5)^2 \tan^2(45° + 5°)$

$R.F. = 18201 (.3249) + (\frac{1}{2})(120)(1.5)^2 (3.0)$

$R.F. = 5914 + 405 = 6319$ lbs.

$\Sigma H = 5936$ lbs. (from stability

$$\therefore\ S.F. = \frac{6319}{5936}$$

$\boxed{S.F. = 1.07 < 1.5 \quad N.G.}$

Basic Retaining Wall Stress Analysis

I. Introduction:

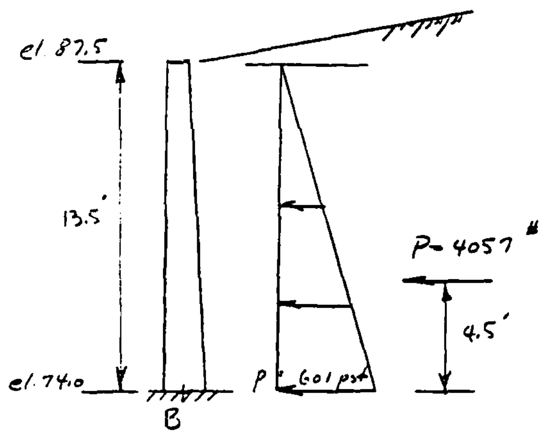
A. Stem, heel, toe designed as cantilever beams.

B. FBD drawn for each member; simple statics to find moments

C. WSD used

D. See fig. 6 for typ. moment shear diagrams.

II. Compute A_s req'd for stem on Exp. prob.



$p = \gamma H K_a = (120)(13.5)(.371) = 601$ psf.

$P = (\frac{1}{2})(601)(13.5) = 4057$ # @ $\frac{1}{3}H$

$M_B = (4057)(4.5) = 18{,}257$ ft-lbs

$V_B = 4057$ lbs.

$N_B = .5(1.0 + 1.5)(13.5)(150) = 2531$

$N_B = 2531$ lbs. (axial load)

Compute A_s req'd (WSD) see fig. 7

$f_s = 20{,}000$

$f_c = .45 f'_c = 1350\text{psi}$ ($.35 f'_c$ if hyd)

$d = 15.5''$

$d' = 2''$

$d'' = 6.5''$

$M = 18.26 \text{ k-ft}$

$N = 2.53 \text{ K}$

$$k = \frac{1}{1 + \frac{f_s}{n f_c}} = \frac{1}{1 + \frac{20000}{9.2(1350)}} = \frac{1}{1 + 1.61} = .3831$$

$$j = 1 - \frac{k}{3} = 1 - \frac{.3831}{3} = .8723$$

$$E = \frac{M}{N} + \frac{d''}{12} = \frac{18.26}{2.53} + \frac{6.5}{12} = 7.22 + .542$$

$E = 7.76 \text{ ft}$

$$A_s = \frac{12000\, N E}{f_s\, j\, d}\left(1 - \frac{j d}{12 E}\right)$$

$$A_s = \frac{(12000)(2.53)(7.76)}{(20000)(.8723)(15.5)}\left(1 - \frac{(.8723)(15.5)}{12(7.76)}\right)$$

$$A_s = .871\,(1 - .145)$$

$$\boxed{A_s = .745 \text{ sq. in.}}$$

Check d against d_{bal} to insure ductility

$$M_r = \tfrac{1}{2} f_c k j b d^2 = \tfrac{1}{2} \frac{(1350)(.3831)(.8723)(12)(15.5)^2}{12000}$$

$M_r = 54.19$ k-ft.

$NE = 2.53(7.76) = 19.63$ k-ft.

$M_r < NE$ ∴ beam depth o.k. (not over-reinf.)

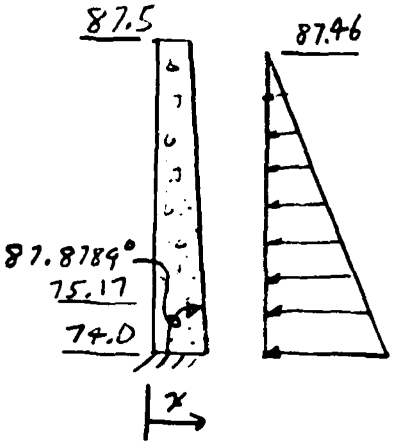
check shear

$$v_c = 1.1\sqrt{f'_c} = 1.1\sqrt{3000} = 60 \text{ psi.}$$

$$v = V/bd = 4057/(12)(15.5) = 21.8 \text{ psi} < 60 \quad \text{o.k.}$$

Stem N, V, M at base (elev. 74.0)

Active earth



6 : 1, $\phi = 30°$ } Coulomb k_a (calculated) $= 0.3879$

$\gamma = 120$ pcf

base pressure $= 120(.3879)(13.5')$

$= 628.398$ psf

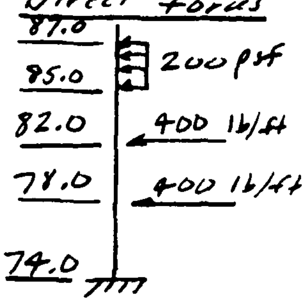
shear $= 628.398(13.5)\frac{1}{2}$

$= 4242$ lb/ft

moment $= 4242(13.5)\frac{1}{3}$

$= 19089$ ft-lb/ft

Direct forces



Shear $= 200(2) + 400 + 400$

$= 1200$ lb/ft

moment $= 400(86-74) + 400(82-74) + 400(78-74)$

$= 4800 + 3200 + 1600$

$= 9600$ lb-ft/ft

dead weight $= 1(13.5)(150) = 2025$ #/1 ▯

$.5(13.5)(150)\frac{1}{2} = 506$ #/1 △

acting at $x = \dfrac{2025(.5) + 506(1 + \frac{.5}{3})}{2025 + 506} = \dfrac{1603}{2531} = 0.633'$

Moment $= 2531\left(\frac{1.5}{2} - .633\right) = 2531(.1167') = 295$ lb-ft/ft

Load case 1 total at base

$N = 2531$ lb/ft

$V = 4242$ lb/ft

$M = 19089 + 296 = 19385$ lb-ft/ft

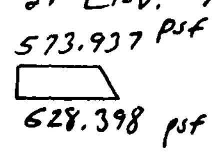
Load case 2 totals at base

$N = 2531$ lb/ft

$V = 4242 + 1200 = 5442$ lb/ft

$M = 19385 + 9600 = 28985$ lb-ft/ft

Shear at Elev. 75.17 ft. (1.17' up)



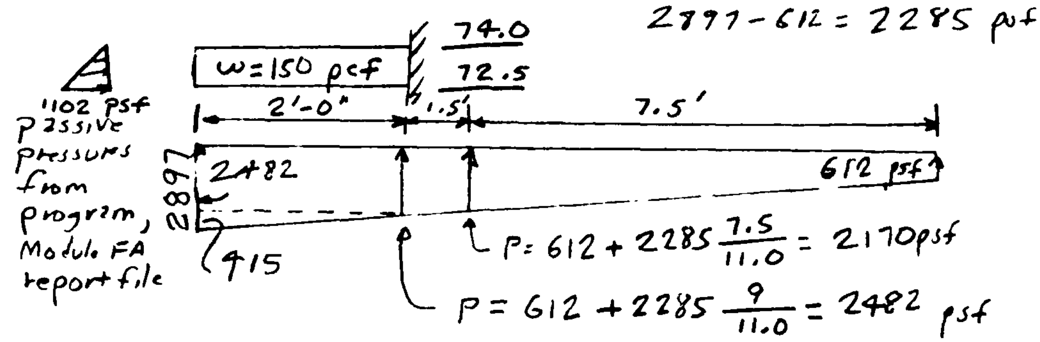
$$\Delta V = \frac{573.937 + 628.398}{2}\, 1.17$$

$$= 703.4 \ \#/_1$$

Load case 2 total shear at Elev. 75.17:

$$V = 5442 - 703 = 4739 \ \#/_1$$

Toe N, V, M at Stem ($x = -0.001$) – Load Case 2



$$V_{@\,stem} = 150(1.5)(2) - 2482\,(2) - \frac{415}{} \; \frac{2}{2}$$

$$= 450 - 4964 - 415 = -4929 \; \#/_1$$

$$M_{@\,stem} = 450\,(1) - 4964\,(1) - 415\left(2\,\tfrac{2}{3}\right) = -5067 \; 1\#/_1$$

adding axial eccentricity moment:

$$M_{@\,stem} = -5067 + 826.5\left(\frac{1.5}{2} - \frac{1.5}{3}\right) = -4860 \; 1\#/_1 \text{ final}$$

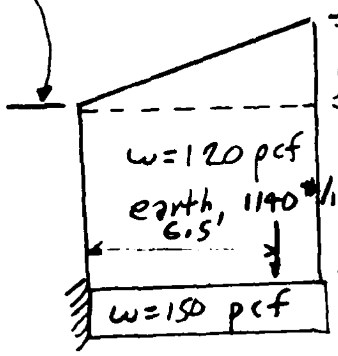
$$N = \frac{1102\,(1.5)}{2} = 826.5 \; \#/_1$$

$$\left(\frac{1.5}{2} - \frac{1.5}{3}\right) = 0.25'$$

Heel N, V, M at stem ($x = 1.501$) - load case 2

$87.46 + \frac{0.5}{6} = 87.5433'$

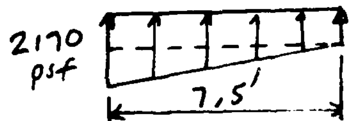
$87.46 + \frac{8.0}{6} = 88.7933'$



$1.25' \times 120 \text{ pcf} = 150 \text{ psf}$

$13.5433' \times 120 \text{ pcf} = 1625.2 \text{ psf}$

74.0'
72.5'



$$\begin{array}{r} 2170 \\ -\ 612 \\ \hline 1558 \end{array}$$

$$V = \frac{150(7.5)}{2} + 1625.2(7.5) + 150(1.5)(7.5) - 612(7.5) - \frac{1558(7.5)}{2}$$

$$= 562.5 + 12189 + 1687.5 - 4590 - 5842.5 = 4006.5 \#/'$$

$$+ 1140 = 5147 \#$$

$$M = 562.5(7.5)\left(\tfrac{2}{3}\right) + 12189\left(\tfrac{7.5}{2}\right) + 1687.5\left(\tfrac{7.5}{2}\right) - 5842.5\left(\tfrac{7.5}{2}\right) - 4006.5\left(\tfrac{7.5}{3}\right)$$

$$+ 1140(6.5)$$

$$= 2812.5 + 45709 + 6328 - 21909 - 10016 + 7410$$

$$= 22925 + 7410 = 30335 \ ^{1\#}/_{1},\ + 13 = 30348 \ ^{1\#}/_{1}$$

N = earth pressure on end of heel

$= \underset{726 \text{ psf}}{\overset{659 \text{ psf}}{\square}} = \frac{659 + 726}{2} 1.5 = 1039 \ \#/'$

axial eccentricity moment $= \underset{67 \text{ psf}}{\triangle} = \frac{67(1.5)}{2}(0.25) = 13 \ ^{1\#}/_{1}$

2-6 COMPARISONS OF RESULTS AND DISCUSSION

2-6-1 Load Case 1 Stability Summary:

Item	Program	Hand Calculation	Difference	Percent of Hand
Resultant ratio	0.4139	0.4133	0.0006	0.15
Sliding factor of safety	1.07	1.07	0	0
Bearing pressure, psf				
Toe end	2504	2515	-11	0.44
Heel end	798	793	5	0.63
Coulomb K_a				
Over heel	0.3711	0.3711	0	0
On stem	0.3879	0.3879	0	0
Active earth force, lb/ft				
Over heel	5908	5936	-28	0.47
On stem	4220	4242	-22	0.52

2-6-2 Load Case 2 Forces and Moments:

Item	Program	Hand Calculation	Difference	Percent of Hand
Stem axial force	2,531	2,531	0	0
Stem shear at base	5,420	5,442	-22	0.4
Stem moment at base	28,827	28,985	-158	0.54
Toe axial force	837	827	10	1.21
Toe shear at stem	--	-4,929	--	--
Toe moment at stem	-4,859	-4,860	1	0
Heel axial force	1,218	1,039	175	17.2
Heel shear	4,996	5,233	-237	4.5
Heel moment	29,234	30,348	1,114	3.7

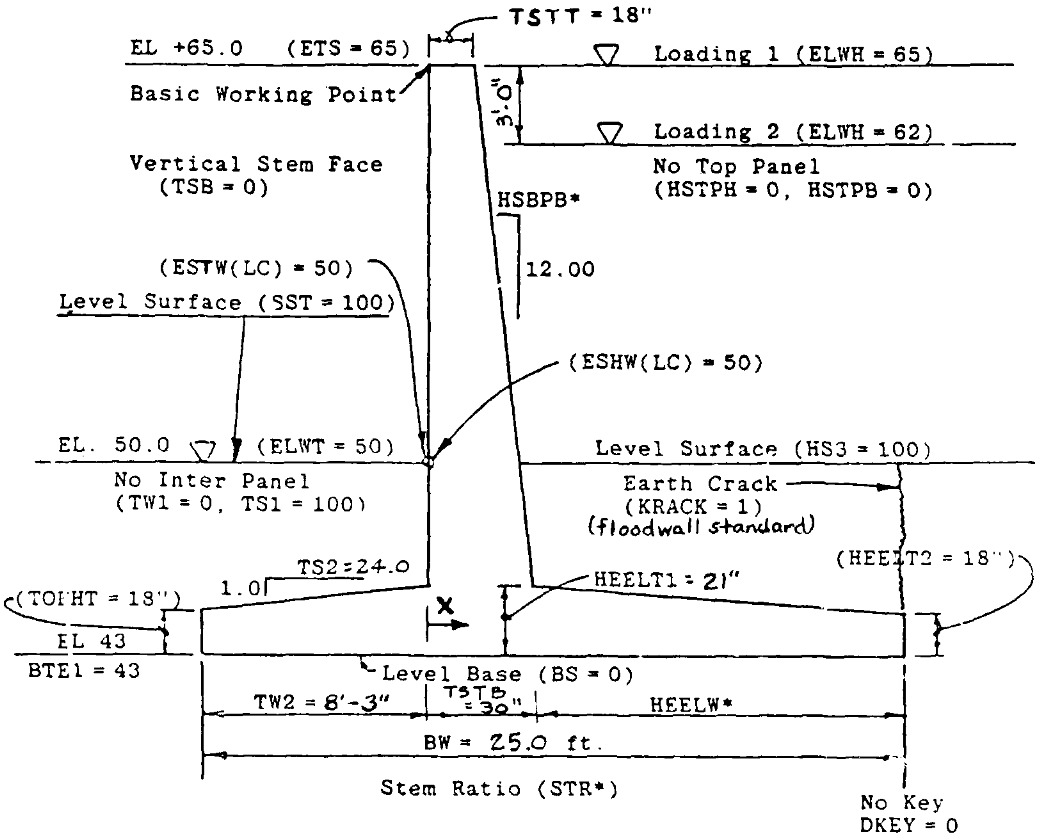
2-6-3 Discussion. The only significant differences are in the heel forces and moments. These differences arise from the way that stability analysis results are transferred to the structural analysis computation modules. For example, active earth forces are the only items contributing to heel axial force, with no seepage and key reaction forces. These forces are lumped from the Coulomb pressure diagram, to be in the same form as the alternate incremental wedge nodal forces. The axial force and moment summation routines for the heel pick up the lumped forces from module SA (run implicitly by module FA) instead of the actual pressures, and so includ[illegible] the pressure acting on an

additional vertical contributing area that may be as high as one half of the spacing between nodes. The nodes are spaced 12 in. apart in this problem, so the error may be as much as 659 psf times 0.5 ft or 329 lb/ft. This is more than the error for this problem of 175 lb/ft. See paragraph 11-4 of the User's Reference Manual for more examples and discussion of these effects.

CHAPTER 3: PROBLEM V2

3-1 DESCRIPTION OF PROBLEM. This problem is the same as example 3 in the Basic User's Guide; i.e., an analysis of a basic floodwall with no difference in finished grade between the two sides of the stem. The backfill and subgrade both have friction and cohesion, and standard floodwall loadings are used:

The objective of this example is to demonstrate stability and member analysis of a basic floodwall. The example is the same wall for the floodwall hand computation example. Data will be in a Command-Data file named EX3DATA. Program control will be interactive at the time-share terminal.



Soils Design Data (SPF3)

γ_s = 125 lb/cf (GAMAS3 = 125)

ϕ = 15° (PHI3 = 15)

C = 400 lb/sf (COH3 = 400)

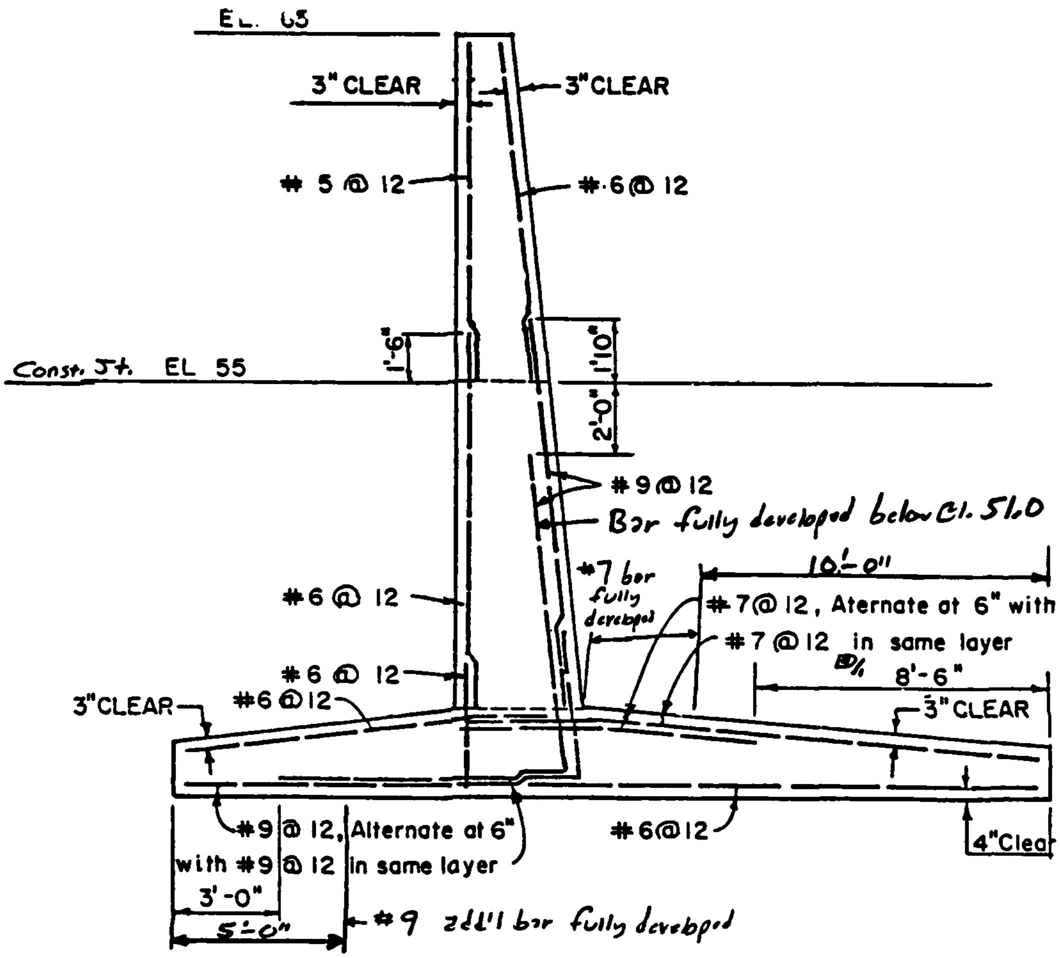
Angle sliding friction on concrete = 15°(PH153 = 15)

Adhesive strength against concrete = 400 lb/sf (ADHS3 = 400)

*To be calculated by program - input value of C in data.

AD-A099 377 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS F/G 13/13
VALIDATION REPORT: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF --ETC(U)
FEB 81 W A PRICE, R L HALL, R L MOSHER
UNCLASSIFIED WES-INSTRUCTION-K-81-3 NL

2 of 4
AD
A099377



Data lists CND and CNWD default values:

f_c = 3000 PSI

f'_c = 0.35 f_c = 1050 PSI (FOR HYDRAULIC STRUCTURES)

f_y = 40,000 PSI

f = 20,000 PSI (FOR HYDRAULIC STRUCTURES)

WALL REINFORCEMENT

3-1-1 Load case 1 has the water elevation over the heel at the top of the stem.

3-1-2 Load case 2 has the water elevation over the heel 3 ft below the top of the stem.

3-2 **DATA PREPARATION.** Paragraph references are to the Basic User's Guide:

Starting Responses, paragraphs 7-2 and 7-3 a

INIT (new problem)

2 (2 load cases)

F (floodwall default values selected)

H (hydraulic structure default values selected)

NAME EXAMPLE 3 -- BASIC FLOOD WALL ANALYSIS

Selection of Data Lists, paragraphs 3-2 and 8-1 thru 8-1-3

Module FA for foundation analysis

Module WA for stress analysis

Preparation of Data Lists, paragraphs 8-3 - 8-11

Soil Surfaces (data lists beginning with the letters "SS"):

* Finished grade over the heel, paragraph 8-3-1 a

list name	LC	ESHW feet	HS3
SSHC	0	50.0	100.0

level ground

0 = "all load cases"

* Finished grade over the toe, paragraph 8-3-1 b

list name	LC	ESTW	SST
SST	0	56.0	100.0

Finished grade of existing soil is not applicable to analysis so data list SSEE is not needed.

Soil Properties (data lists beginning with the letters "SP"):

* Subgrade data list SPE3, paragraph 8-4-1:

list name	PHI3 ϕ	COH3 C, psf	GAMAS3 γ_s, pcf	PHIS3 $\phi_{sliding}$	ADHS3 sliding adhesion, psf	
SPE3	15.0	400.0	125.0	15.0	400.0 →	truncate the list here since allowable bearing pressures are not stored

Data lists SPH1 and SPT7 are not needed because the backfill soils data are the same as for the subgrade soil and the following default values are valid (paragraph 8-4-2 a):

RKA1 is to be calculated

DELTA1 is zero

RKAE1 is zero

HCMIN is immaterial for analysis.

Foundation Design parameters

Data list SOLP, paragraph 8-5-1, is not needed because all of the default values are acceptable.

Data list RRD, paragraph 8-5-2, is not needed for analysis.

Water

* Data list SEEP, paragraph 8-6-1:

list name	LC	ELWT feet	ELWH feet	
SEEP	1	50.0	65.0 →	truncate the list here since "C" is valid for the rest of the values in the list.
SEEP	2	50.0	62.0 →	

Data list BOIL is not needed because there are no data for sheet pike cutoff criteria.

Surcharge data lists are not needed (paragraph 8-7-1)

Wall geometry data for analysis, paragraph 8-8-3a
(Data lists beginning with the letters "WLA"):

	list name	ETS feet	TW2 feet	STR	HEELW feet
★	WLA	65.0	8.25	C	C

	list name	BW feet	BW1 for ABP3 $^{T}_{IN}$	BW2 for ABP3 $^{T}_{BW}$	BS
★	WLAB	25.0	24.0	26.0	0.0

	list name	HEELT2 inches	HEELW feet	HEELT1 inches
☆	WLAH	18.0	C	21.0

WLAK is not needed because there is no key

	list name	TSTT inches	TSB in/ft	TSTB inches	HSTPH feet	HSTPB in/ft	HSBPB in/ft
★	WLAS	18.0	0.0	30.0	0.0	0.0	C

	list name	BTE1 feet	TOEHT inches	TS2	TW1 feet	TS1
★	WLAT	43.0	18.0	24.0	0.0	100.0

WLBR is not needed since the wall alignment is straight

-- data complete for module FA --

Reinforcing Steel data, paragraph 8-9:

Data list COVR is not needed because the default values in paragraph 8-9-1 are acceptable.

* Stem, paragraph 8-9-3

at top (LOC = 1): ASTLST(1) = #5@12 = 0.31 $\boxed{in}/1$

ASTLSH(1,1) = #6@12 = 0.44 $\boxed{in}/1$

at El. 55 (LOC = 11): ASTLST(11) = #6@12 = 0.44 $\boxed{in}/1$

ASTLSH(11,1) = #9@12 = 1.00 $\boxed{in}/1$

at El. 51 (LOC = 15): ASTLST(15) = same as above

ASTLSH(15,1) = #9@6 = 2.00 $\boxed{in}/1$

at El. 46 = top of base, steel is same as above

list name	LOC	ASTLST(LOC) $\boxed{in}/1$	LN	ASTLSH(LOC, LN) $\boxed{in}/1$
STLS	1	0.31	1	0.44
STLS	11	0.44	1	1.00
STLS	15	(S or 0.44)	1	2.00

* Toe, paragraph 8-9-5 (a)

at outer end (LOC = 1): ASTLBT(1,1) = #6@12 = 0.44 $\boxed{in}/1$

ASTLBB (1,1) = #9@12 = 1.00 $\boxed{in}/1$

5' from outer end (LOC = 6): ASTLBT (6,1) = same

ASTLBB (6,1) = #9@6 = 2.00 $\boxed{in}/1$

@ 8' from outer end, steel is same as at 5' from outer end.

list name	LOC	LNA	ASTLBT(LOC, LNA) sq in/ft	LNB	ASTLBB(LOC, LNB) sq in/ft.
STLB	1	1	0.44	1	1.00
STLB	6	1	(S or 0.44)	1	2.00

* Heel, paragraph 8-9-5 (b)

LOC value at outer end:

$$\underbrace{BW+1.9999}_{4\ decimals} = 25.0+1.9999 = \underbrace{26}_{LOC=26\ @\ end}.9999$$

@ outer end (LOC = 26): ASTLBT (1,1) = #7@12 = 0.6 $\boxed{in}$/1

ASTLBB (1,1) = #6@12 = 0.44 $\boxed{in}$/1

10' from outer end (LOC = 16): ASTLBT(1,1) = #7 @ 6 = 1.20 $\boxed{in}$/1

ASTLBB(1,1) = same as at end

Steel at stem is same as at LOC = 16

list name	LOC	LNA	ASTLBT (LOC,LNA) sq in/ft	LNB	ASTLBB (LOC,LNB) sq in/ft
STLB	26	1	0.60	1	0.44
STLB	16	1	1.20	1	(S or 0.44)

Concrete analysis parameters, paragraph 8-10

Data lists CND and CNWD are not needed because all of the default values are acceptable.

Data list STLD is not applicable to analysis.

Cost data, paragraph 8-11

Not needed because there is no boundary defined between existing and back-fill soil systems and because no cost data are given.

DATA READY -- BUILD DATA FILE

DATA FILE:

```
*OLD EX3DATA
*1040 NAME  EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
*SAVE EXV2DAT
DATA SAVED-EXV2DAT

*LIST EXV2DAT

1000 INIT
1010 2
1020 F
1030 H
1040 NAME  EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
2000 SSHC 0  50.0  100.0
2010 SST  0  50.0  100.0
3000 SPE3  15.0  400.0  125.0  15.0  400.0
3010 SEEP  1  50.0  65.0
3020 SEEP  2  50.0  62.0
4000 WLA  65.0  8.25  C  C
4010 WLAB  25.0  24.0  26.0  0.0
4020 WLAH  18.0  C  21.0
4030 WLAS  18.0  0.0  30.0  0.0  0.0  C
4040 WLAT  43.0  18.0  24.0  0.0  100.0
5000 STLS   1  0.31  1  0.44
5010 STLS  11  0.44  1  1.00
5020 STLS  15   S    1  2.00
5100 STLB  1  1  0.44  1  1.00
5110 STLB  6  1   S    1  2.00
5200 STLB  26  1  0.60  1  0.44
5210 STLB  16  1  1.20  1   S
6000 UPDATE
```

3-3 TIME-SHARING TERMINAL INPUT/OUTPUT:

```
*FORTRAN
*RUN WESLIB/TWDA,R

        09/17/80    12.108

:

PROGRAM TWDA -- 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
       REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EXV2UPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?W.A.PRICE
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?EXV2DAT
PROCESSING DATA FILE...

NOT ENOUGH VALUES ENTERED IN DATA LIST - SPE3
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'

::
:: UPDATE FILE RESET
::

::
:: DATA FILE PROCESSING DONE
::
:: RETURN TO INTERACTIVE INPUT
::

COMMAND
?RUN FA


THE RESULTANT RATIO =       0.2420, FOR LOAD CASE  1


THE RESULTANT RATIO =       0.3611, FOR LOAD CASE  2
```

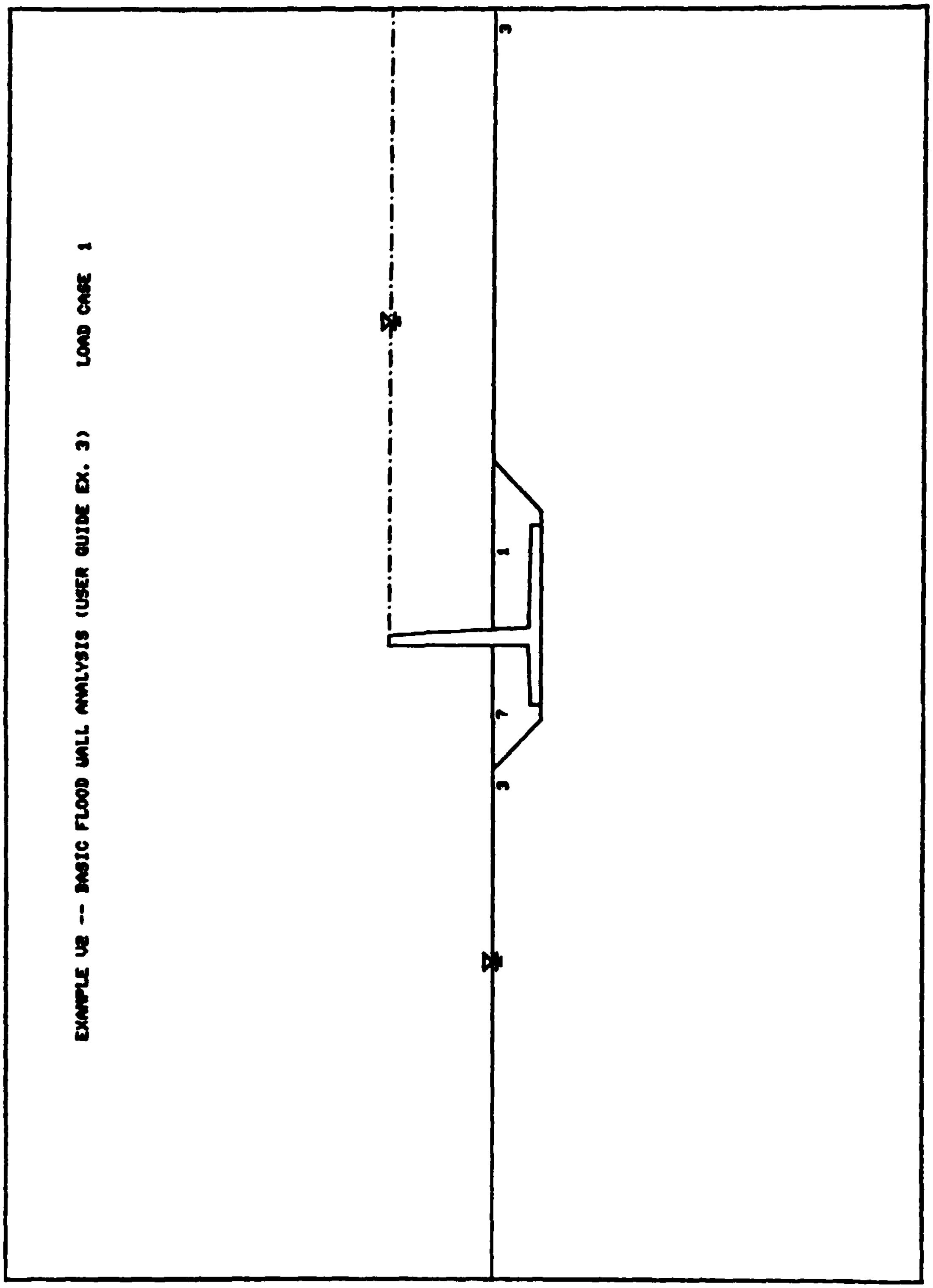
```
FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.73, FOR LOAD CASE  1
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS


FINAL FACTOR OF SAFETY AGAINST SLIDING =      2.68, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS


TOTAL CONCRETE VOLUME =         81.82 (CU FT / LF), FOR LOAD CASE  1


TOTAL CONCRETE VOLUME =         81.82 (CU FT / LF), FOR LOAD CASE  2

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
   OR 0 TO OMIT THE PLOTS
?0

:
: UPDATE FILE RESET
:



:
: COMMAND-DATA PHASE ENTERED
:

COMMAND
?RUN WA
:
: BEGIN MODULE WA
:

ENTER 1 TO SEE A TABLE OF X AND Y CORNER COORDINATES
   OR C TO CONTINUE WITHOUT SEEING THE TABLE
?C

TO GET DEFAULT VALUE FOR "IFEM", ANSWER NEXT QUESTION WITH A CARRIAGE RETURN:

::: IFEM IS NOT DEFINED, SO YOU MUST
    ENTER 0 TO USE LOAD CASES AS-IS
    OR    1 TO ALSO USE EM ALTERNATE SPECIAL LOADINGS
            (A CARRIAGE RETURN WILL INSERT THIS DEFAULT
            VALUE OF 1)
    OR    ? FOR MORE INFORMATION
    OR    C TO CONTINUE DATA CHECK WITHOUT COMPUTATIONS
    OR    * TO ABORT THE MODULE
?0

:
: BEGIN STRESS ANALYSIS
:
```

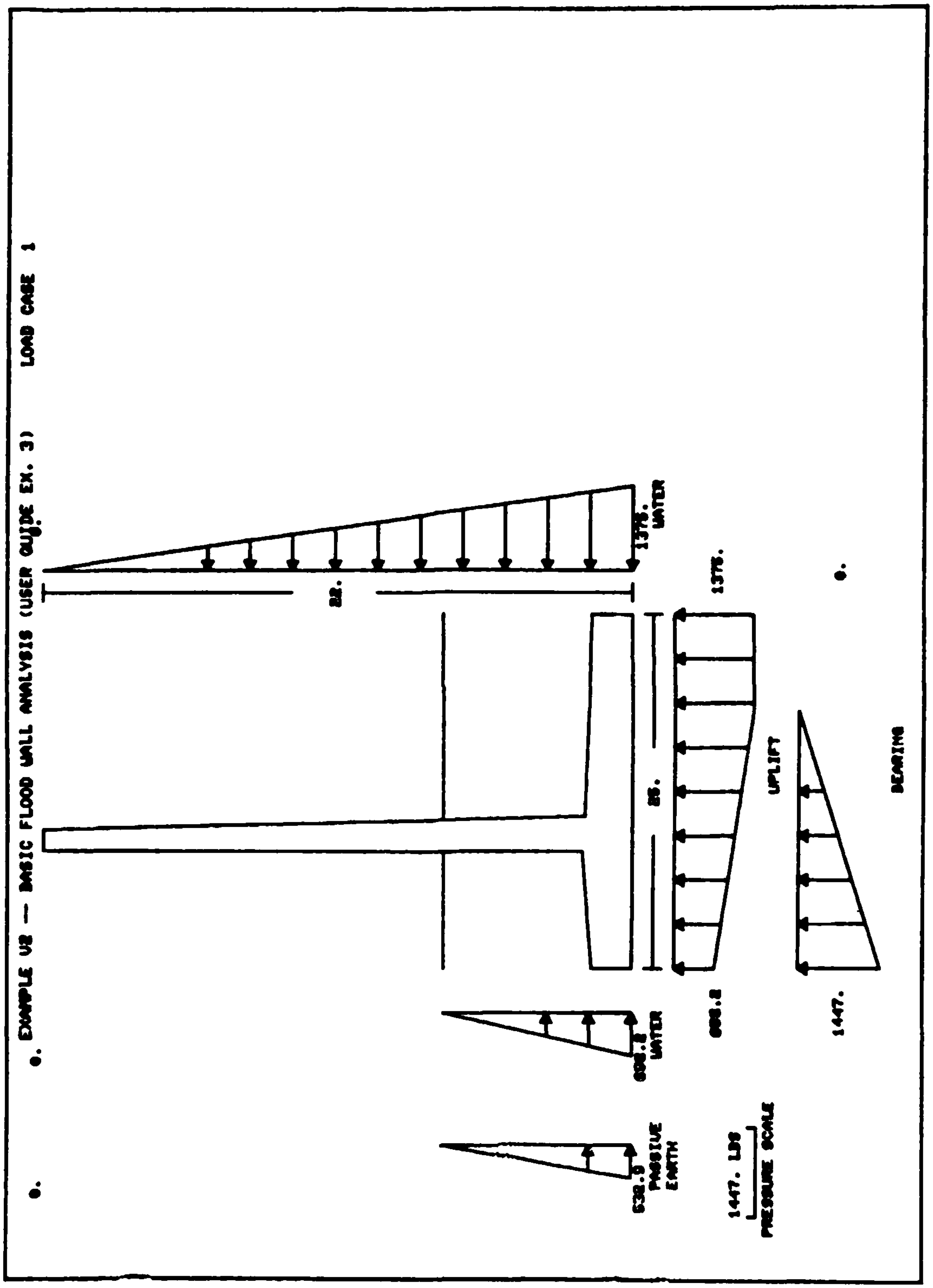
```
ENTER T TO GET THE ANALYSIS RESULTS AT YOUR TERMINAL
   OR R TO PUT THEM IN THE REPORT FILE
   OR B TO PUT THEM BOTH PLACES
?R

ENTER THE LOAD CASE NUMBER YOU WANT ANALYZED
   OR A ZERO FOR ALL LOAD CASES IN DATA LIST "CASE"
   OR * TO STOP THE MODULE
?0

*
* BEGIN STEM STRESS ANALYSIS
*

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *):
?C

STEM ANALYSIS COMPLETE TO BASE

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *):
?N

*
* BEGIN TOE STRESS ANALYSIS
*

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *):
?C

TOE ANALYSIS COMPLETE TO STEM

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *):
?N

*
* BEGIN HEEL STRESS ANALYSIS
*

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *):
?C

HEEL ANALYSIS COMPLETE TO END

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *):
?N

*
* MODULE WA COMPLETE
*

*
* UPDATE FILE RESET
*
```

```
:
: COMMAND-DATA PHASE ENTERED
:

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?5
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
?R0

SNUMB # 2462A

YOUR UPDATE FILE FOR FUTURE RESTART IS NAMED EXV2UPD
STOP     OK (RELEASE UNNEEDED FILES)

*
```

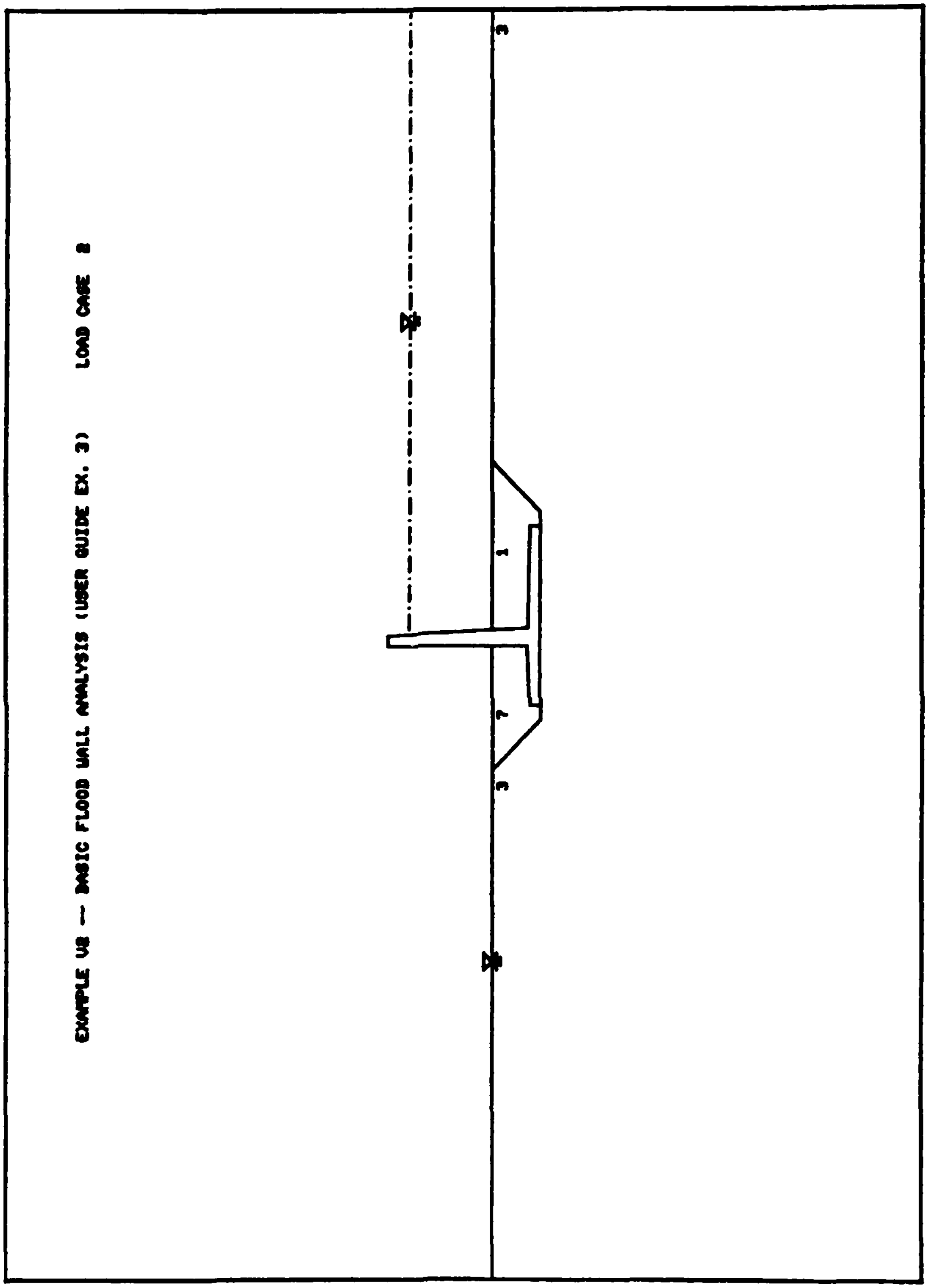
```
*FORTRAN
*RUN WESLIB/TWDA,R

          09/18/80    09.754


PROGRAM TWDA -- 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
       REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EXV2TEMP


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?W.A.P.
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?


IS THIS AN INITIAL RUN OR A RESTART OF A PREVIOUS RUN?
ENTER 'INIT' OR 'REST'

COMMAND
?REST EXV2UPD

$- ALL DATA RESET FOR FRESH START -$
$- COMMON DATA RESET FROM RESTART FILE EXV2UPD , UPDATE FILE RESET -$

COMMAND
?RUN FA


THE RESULTANT RATIO =      0.2420, FOR LOAD CASE  1


THE RESULTANT RATIO =      0.3611, FOR LOAD CASE  2


FINAL FACTOR OF SAFETY AGAINST SLIDING =     1.73, FOR LOAD CASE  1
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS


FINAL FACTOR OF SAFETY AGAINST SLIDING =     2.68, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD


  C'=C/FS+2C'     TANPHI'=TANPHI/FS


TOTAL CONCRETE VOLUME =         81.82 (CU FT / LF), FOR LOAD CASE  1


TOTAL CONCRETE VOLUME =         81.82 (CU FT / LF), FOR LOAD CASE  2

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
   OR 0 TO OMIT THE PLOTS
?1
```

```
NOTE --- A BELL WILL RING AT SELECTED TIMES
         TO ALLOW YOU TO MAKE A HARDCOPY IF
         YOU SO DESIRE. TO RESUME EXECUTION
         SIMPLY ENTER A CARRIAGE RETURN

ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      3 TO TERMINATE GRAPHICS
?1
ACTIVE LOAD CASES
------ ---- -----
                1
                2
ENTER DESIRED ACTIVE LOADCASE
?1
```

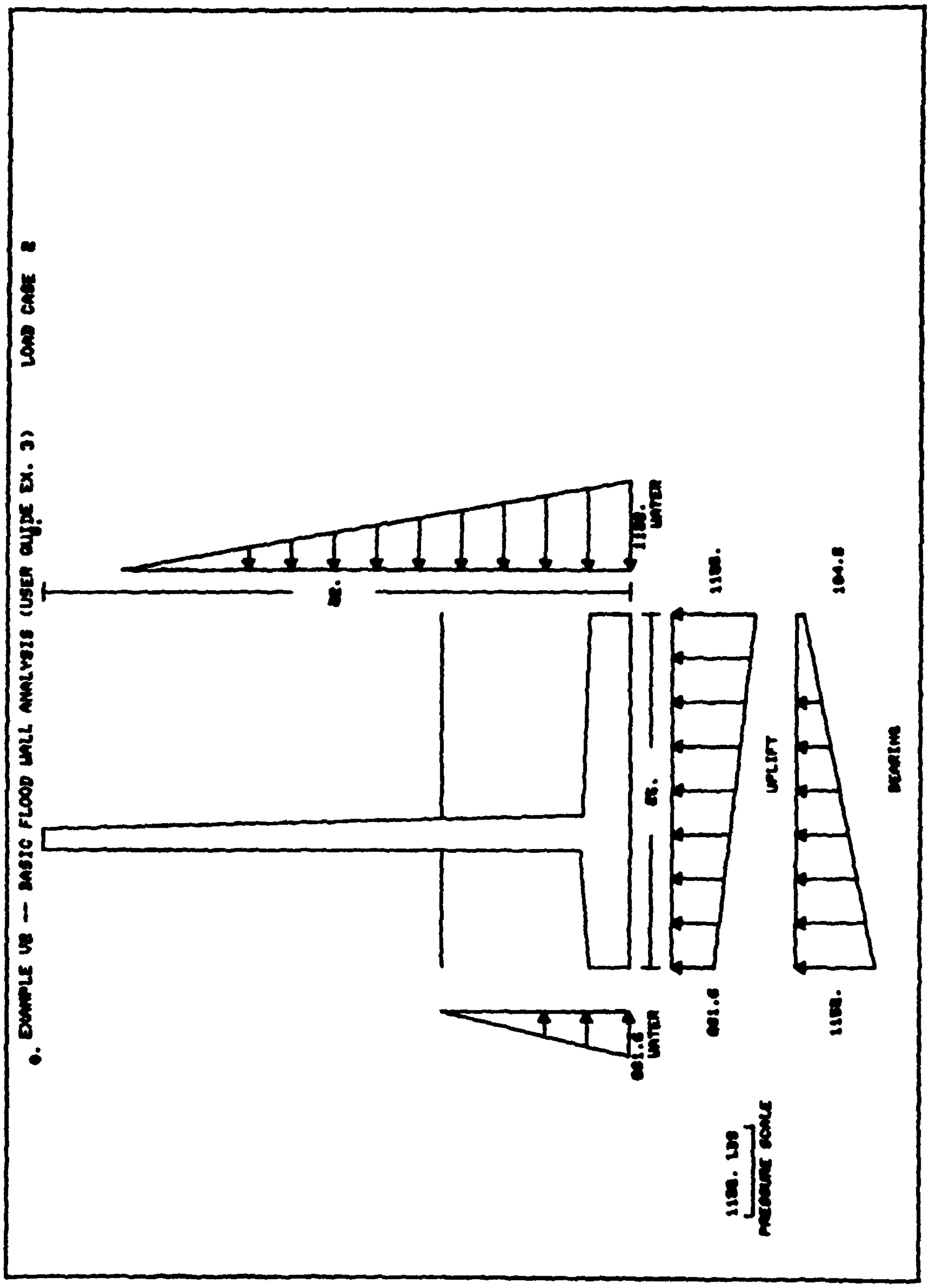

EXAMPLE UG -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
LOAD CASE 1
3
1
7
3



EXAMPLE U2 — BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
LOAD CASE 1
0.
1376.
WATER
22.
1376.
26.
UPLIFT
BEARING
0.
WATER
1447.
PASSIVE
EARTH
1447. LBS
PRESSURE SCALE



EXAMPLE US -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
LOAD CASE 8
3
1
7
3


EXAMPLE — BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
LOAD CASE
WATER
WATER
UPLIFT
BEARING
PRESSURE SCALE

```
ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      3 TO TERMINATE GRAPHICS
?3
$$$

$
$ UPDATE FILE RESET
$


$
$ COMMAND-DATA PHASE ENTERED
$

COMMAND
?END

ENTER 5 TO SEND REPORT TO ASPC TERMINAL
   OR 6 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?1

your update file for future restart is named EXU3TEMP
stop    OK (release unneeded files)

$RELE EXU3TEMP
FILE RELEASED-EXU3TEMP
$
```

3-4 REPORT FILE PRINTOUT:

```
RRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRR
          12: 7: 3 ON  9/17/80


 NOTES TO EXPLAIN SPECIAL PRINTOUT THAT MIGHT BE IN THIS FILE--

 THE VALUE "-.1234E+31" IS USED TO DENOTE AN  UNDEFINED ITEM;
 THE VALUE "-.1432E+31" MEANS THAT THE DEFAULT VALUE WAS REQUESTED.

 A "MEMORY FAULT AT ..." MESSAGE PROBABLY MEANS THAT NEEDED DATA IS UNDEFINED.

.

 END OF NOTES.

 COMMAND ENTERED:
 INIT

 *- ALL DATA RESET FOR FRESH START -*

 COMMAND ENTERED:
 F

 COMMAND ENTERED:
 H
```

```
         12: 8:32 ON  9/17/80

WALL DECLARED TO BE A HYDRAULIC FLOOD WALL

COMMAND ENTERED:
NAME  EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)

COMMAND ENTERED:
SSHC 0  50.0  100.0

COMMAND ENTERED:
SSL  0  50.0  100.0

COMMAND ENTERED:
SPE3  15.0  400.0  125.0  15.0  400.0

NOT ENOUGH VALUES ENTERED IN DATA LIST - SPE3
TRAILING VALUES SET TO "C"

COMMAND ENTERED:
SEEP  1  50.0  65.0

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO "C"

COMMAND ENTERED:
SEEP  2  50.0  62.0

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO "C"

COMMAND ENTERED:
WLA  65.0  8.25  C  C

COMMAND ENTERED:
WLAB  25.0  20.0  26.0  0.0

COMMAND ENTERED:
WLAH  18.0  C  21.0

COMMAND ENTERED:
WLAS  18.0  0.0  30.0  0.0  0.0  C

COMMAND ENTERED:
WLAT  43.0  18.0  20.0  0.0  100.0

COMMAND ENTERED:
STLS   1  0.31  1  0.00

COMMAND ENTERED:
STLS  11  0.44  1  1.00

COMMAND ENTERED:
STLS  15   S    1  2.00

COMMAND ENTERED:
STLB  1  1  0.44  1  1.00

COMMAND ENTERED:
STLB  6  1   S    1  2.00

COMMAND ENTERED:
STLB  26  1  0.60  1  0.44
```

```
COMMAND ENTERED:
STLR  16 1  1,20  1    S

COMMAND ENTERED:
UPDATE

#
# UPDATE FILE RESET
#




EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
        12:11:57 ON  9/17/80


#
# BEGIN BASIC STABILITY DATA CHECK
#

DEFAULT VALUE OF     62.50000     USED FOR GAMAW      (LOAD CASE  1)

DEFAULT VALUE OF     150.0000     USED FOR GAMAC      (LOAD CASE  1)

DEFAULT VALUE OF     1.000000     USED FOR FSS        (LOAD CASE  1)

DEFAULT VALUE OF     2.000000     USED FOR FXW        (LOAD CASE  1)

DEFAULT VALUE OF    0.                USED FOR UCFXS3     (LOAD CASE  1)

DEFAULT VALUE OF    0.                USED FOR UCFXS4     (LOAD CASE  1)

DEFAULT VALUE OF    0.                USED FOR UCFXS5     (LOAD CASE  1)

DEFAULT VALUE OF    0.                USED FOR UCRES1     (LOAD CASE  1)

DEFAULT VALUE OF    0.                USED FOR UCRES2     (LOAD CASE  1)

DEFAULT VALUE OF    0.                USED FOR UCREF7     (LOAD CASE  1)

DEFAULT VALUE OF    0.                USED FOR UCRES7     (LOAD CASE  1)

DEFAULT VALUE OF    0.                USED FOR UCRES6     (LOAD CASE  1)

DEFAULT VALUE OF     1.000000     USED FOR UCWS       (LOAD CASE  1)

DEFAULT VALUE OF     1.000000     USED FOR UCWR       (LOAD CASE  1)

DEFAULT VALUE OF     1.000000     USED FOR UCWK       (LOAD CASE  1)

DEFAULT VALUE OF            2     USED FOR IFWOC      (LOAD CASE  1)

DEFAULT VALUE OF            1     USED FOR IFSOM      (LOAD CASE  1)
```

```
DEFAULT VALUE OF     1.000000     USED FOR CEMA       (LOAD CASE  1)
NO DEFAULT VALUE FOR RRMIN       SO SET TO UNDEFINED  (LOAD CASE  1)
DEFAULT VALUE OF            1     USED FOR KRACK      (LOAD CASE  1)
DEFAULT VALUE OF     1.500000     USED FOR FSMIN      (LOAD CASE  1)
DEFAULT VALUE OF            2     USED FOR NSLIDE     (LOAD CASE  1)
DEFAULT VALUE OF    0.            USED FOR HGSW       (LOAD CASE  1)
DEFAULT VALUE OF            2     USED FOR IEWOC      (LOAD CASE  2)
DEFAULT VALUE OF            1     USED FOR IESOM      (LOAD CASE  2)
DEFAULT VALUE OF     1.000000     USED FOR CEMA       (LOAD CASE  2)
NO DEFAULT VALUE FOR RRMIN       SO SET TO UNDEFINED  (LOAD CASE  2)
DEFAULT VALUE OF            1     USED FOR KRACK      (LOAD CASE  2)
DEFAULT VALUE OF     1.500000     USED FOR FSMIN      (LOAD CASE  2)
DEFAULT VALUE OF            2     USED FOR NSLIDE     (LOAD CASE  2)
DEFAULT VALUE OF    0.            USED FOR HGSW       (LOAD CASE  2)
DEFAULT VALUE OF     100.0000     USED FOR HSSSH      (LOAD CASE  1)
DEFAULT VALUE OF    0.            USED FOR DTSSH      (LOAD CASE  1)




EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
          12:11:57 ON  9/17/80


#
# BEGIN PART 2 OF STABILITY DATA CHECK
#
```

EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
12:11:57 ON 9/17/80

#
BEGIN MODULE FA
#

VARIABLE HEELW CALCULATED 14.25 (BW-TW2-TSTB)
VARIABLE HSRPB CALCULATED OR DEFAULTED TO CLOSE COORDINATES.
HSRPB = 0.592593 IN/FT.

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	65.0000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	0.	44.8438	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	0.	44.8438	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-8.2500	44.5000	TOP OF TOEHT = AT OUTER END OF TW2
5	-8.2500	43.0000	TOE END OF BASE = AT BTE1
10	16.7500	43.0000	HEEL END OF BASE
11	16.7500	44.5000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	2.5000	44.7500	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.5000	65.0000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.5000	65.0000	TOP OF HEEL-SIDE FACE OF STEM

HORIZONTAL NON-SEEPAGE PRESSURES ARE ZERO
BECAUSE YOUR KRACK VALUE OF 1 CANCELS ACTIVE EARTH
AND BECAUSE PRESSURES W3 AND/OR W4 (DATA LIST SCWH)
ARE UNDEFINED, ZERO, OR NEGATIVE.

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 1

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	12273.63	0.	132834.67
ACTIVE EARTH	0.	0.	0.
SOIL+WATER	29103.57	0.	439933.80
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	41377.20	0.	572768.47

HORIZONTAL NON-SEEPAGE PRESSURES ARE ZERO
BECAUSE YOUR KRACK VALUE OF 1 CANCELS ACTIVE EARTH
AND BECAUSE PRESSURES W3 AND/OR W4 (DATA LIST SCWH)
ARE UNDEFINED, ZERO, OR NEGATIVE.

```
THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND
THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT
ARE NOT INCLUDED HERE.  "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE
IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.
```

LOAD CASE 2

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	12273.63	0.	132834.67
ACTIVE EARTH	0.	0.	0.
SOIL+WATER	25798.88	0.	385582.24
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	38072.52	0.	518416.91

```
EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
        12:11:60 ON  9/17/80


#
# BEGIN THE OVERTURNING COMPUTATION
#


    LOAD CASE    1


 DEFAULT VALUE OF            1       USED FOR ISET(LC)    (LOAD CASE  1)

 DEFAULT VALUE OF            1       USED FOR NPPD(LC)    (LOAD CASE  1)

RESULTANT IS OUTSIDE THE KERN ON THE TOE SIDE


 EFFECTIVE BASE =  18.18 (FT),
 COORDINATES OF ZERO PRESSURE ON THE BASE:
    XZ =   9.35 AND YZ =  93.00
```

```
CREEP PATH DESCRIPTION FOR LOAD CASE 1

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
   16.75              65.00                  0.
   16.75              43.00               1375.00
    9.93              43.00               1375.00
   -8.25              43.00                698.17
   -8.25              50.00                  0.

 OVERTURNING HYDRAULIC GRADIENT  =  0.5958


 > VALUE OF HPPD(LC)    FOUND =           1       IN S/R CHEKIT (LOAD CASE  1)

 > VALUE OF ADHS3       FOUND =    400.0000       IN S/R CHEKRT (LOAD CASE  1)

 > VALUE OF PHIS3       FOUND =    15.00000       IN S/R CHEKRT (LOAD CASE  1)

 > VALUE OF ADHS4       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  1)

 > VALUE OF ADHS5       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  1)

 > VALUE OF PHIS4       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  1)

 > VALUE OF PHIS5       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  1)


   AT BASE-SOIL INTERFACE:
     WEIGHTED AVERAGE COEFFICIENT OF FRICTION =         0.27
     WEIGHTED AVERAGE ADHESION                =       400.00 (LBS/SQ.FT)
     EFFECTIVE BASE WIDTH                     =        18.18 (FEET)
     EFFECTIVE LENGTH ALONG BASE SLOPE        =        18.18 (FEET)
     NORMAL FORCE ACTING ON BASE              =     13152.91 (LBS/SLICE)
     FRICTIONAL FORCE                         =      3524.31 (LBS/SLICE)
     FORCE DUE TO ADHESION                    =      7270.06 (LBS/SLICE)
     TOTAL FORCE ALONG BASE                   =     10794.38 (LBS/SLICE)
     HORIZONTAL COMPONENT OF TOTAL FORCE      =     10794.38 (LBS/SLICE)


 PASSIVE EARTH PRESSURES FOR LOAD CASE  1

 HPPD                                  =            1
 ELEVATION OF TOP OF SOIL              =   50.082      (FT)
 PRESSURE AT TOP OF SOIL               =  0.           (LBS/SQ.FT)
 ELEVATION AT BOTTOM OF TOE            =   43.000      (FT)
 PRESSURE AT BOTTOM OF TOE             =  -532.87      (LBS/SQ.FT)
 ELEVATION OF LOWEST POINT ON WALL     =   43.000      (FT)
 PRESSURE AT LOWEST POINT ON WALL      =  -532.87      (LBS/SQ.FT)
 PASSIVE EARTH FORCE                   =  -1887.0      (LBS/SLICE)
 PASSIVE EARTH MOMENT                  =   1454.9      (FT-LBS/SLICE)

 DISTANCE FROM THE TOE TO THE RESULTANT          =  6.05 (FT)
 VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE   =   -28225.30 (LBS/SLICE)
 HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES   =    12681.31 (LBS/SLICE)
 MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES  =  -497649.78 (FT-LBS/SLICE)

THE RESULTANT RATIO =       0.2420, FOR LOAD CASE  1
```

LOAD CASE 2

DEFAULT VALUE OF 1 USED FOR ISET(LC) (LOAD CASE 2)

DEFAULT VALUE OF 1 USED FOR NPPD(LC) (LOAD CASE 2)

RESULTANT IS WITHIN THE KERN

CREEP PATH DESCRIPTION FOR LOAD CASE 2

X-COORDINATES	Y-COORDINATES	HYDROSTATIC PRESSURE
16.75	62.00	0.
16.75	43.00	1187.50
-8.25	43.00	601.56
-8.25	50.00	0.

OVERTURNING HYDRAULIC GRADIENT = 0.3750

```
> VALUE OF NPPD(LC)   FOUND =          1     IN S/R CHEKIT (LOAD CASE  2)

> VALUE OF ADHS3      FOUND =   400.0000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF PHIS3      FOUND =   15.00000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF ADHS4      FOUND =  0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF ADHS5      FOUND =  0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF PHIS4      FOUND =  0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF PHIS5      FOUND =  0.            IN S/R CHEKRT (LOAD CASE  2)
```

```
AT BASE-SOIL INTERFACE:
  WEIGHTED AVERAGE COEFFICIENT OF FRICTION =      0.27
  WEIGHTED AVERAGE ADHESION                =    400.00 (LBS/SQ.FT)
  EFFECTIVE BASE WIDTH                     =     25.00 (FEET)
  EFFECTIVE LENGTH ALONG BASE SLOPE        =     25.00 (FEET)
  NORMAL FORCE ACTING ON BASE              =  15709.23 (LBS/SLICE)
  FRICTIONAL FORCE                         =   4209.28 (LBS/SLICE)
  FORCE DUE TO ADHESION                    =  10000.00 (LBS/SLICE)
  TOTAL FORCE ALONG BASE                   =  14209.28 (LBS/SLICE)
  HORIZONTAL COMPONENT OF TOTAL FORCE      =  14209.28 (LBS/SLICE)
```

```
PASSIVE EARTH PRESSURES FOR LOAD CASE  2

NPRD                                   =          1
ELEVATION OF TOP OF SOIL               =    50.082        (FT)
PRESSURE AT TOP OF SOIL                =   0.             (LBS/SQ.FT)
ELEVATION AT BOTTOM OF TOE             =    43.000        (FT)
PRESSURE AT BOTTOM OF TOE              =   0.             (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL      =    43.000        (FT)
PRESSURE AT LOWEST POINT ON WALL       =   0.             (LBS/SQ.FT)
PASSIVE EARTH FORCE                    =   0.             (LBS/SLICE)
PASSIVE EARTH MOMENT                   =   0.             (FT-LBS/SLICE)

DISTANCE FROM THE TOE TO THE RESULTANT            =   9.03 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE     =   -22363.28 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES     =     9175.78 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES    =  -376593.75 (FT-LBS/SLICE)

THE RESULTANT RATIO =       0.3611, FOR LOAD CASE  2
```

```
EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
        12:12: 0 ON  9/17/80



#
# BEGIN SLIDING COMPUTATION
#



 FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.73, FOR LOAD CASE  1
 BY ALLOWABLE STRENGTH METHOD
   C'=C/FS+2C'      TANPHI'=TANPHI/FS

     SUM OF DRIVING FORCES  = 12681.392 (LBS/SLICE)
     SUM OF RESISTING FORCES = 12692.044 (LBS/SLICE)

     PASSIVE EARTH FORCE                       =   5470.27 (LBS/SLICE)
     ACTIVE EARTH FORCE                        =      0.   (LBS/SLICE)
     UPLIFT FORCE                              = -28224.29 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =  12681.39 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
          X           Y
        -8.25       43.00
        16.75       43.00

 FINAL FACTOR OF SAFETY AGAINST SLIDING =      2.68, FOR LOAD CASE  2
 BY ALLOWABLE STRENGTH METHOD
   C'=C/FS+2C'      TANPHI'=TANPHI/FS

     SUM OF DRIVING FORCES  =  9175.781 (LBS/SLICE)
     SUM OF RESISTING FORCES =  9176.080 (LBS/SLICE)

     PASSIVE EARTH FORCE                       =   4062.08 (LBS/SLICE)
     ACTIVE EARTH FORCE                        =      0.   (LBS/SLICE)
     UPLIFT FORCE                              = -22363.28 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =   9175.78 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
          X           Y
        -8.25       43.00
        16.75       43.00
```

```
EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
        12:12: 6 ON  9/17/80


#
#  BEGIN ALLOWABLE BEARING CAPACITY COMPUTATIONS
#


FIRST SET TO 10 FEET BELOW LOWEST POINT ON BASE

 ALLOWABLE BEARING PRESSURES WILL NOT BE COMPARED
 TO THE ACTUAL BEARING PRESSURES BECAUSE THE ALLOWABLES WERE NOT DEFINED.


 FOR LOAD CASE  1,

 FOR THE BASE COORDINATES  X= -8.25  Y= 43.00, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE        =   1447.24 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X=  9.93  Y= 43.00, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE        =       0.   (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 16.75  Y= 43.00, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE        =       0.   (LBS/SQ.FT)


 FOR LOAD CASE  2,

 FOR THE BASE COORDINATES  X= -8.25  Y= 43.00, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE        =   1151.98 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X= 16.75  Y= 43.00, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE        =    190.76 (LBS/SQ.FT)
```

EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
12:12: 7 ON 9/17/80

#
BEGIN COST ANALYSIS
#

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	0.	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	0.	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	40.38	1.00	40.38
BASE	41.44	1.00	41.44
KEY	0.	1.00	0.

TOTAL CONCRETE VOLUME = 81.82 (CU FT / LF), FOR LOAD CASE 1

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	115.84	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	77.24	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	40.38	1.00	40.38
BASE	41.44	1.00	41.44
KEY	0.	1.00	0.

TOTAL CONCRETE VOLUME = 81.82 (CU FT / LF), FOR LOAD CASE 2

```
#
# BEGIN HOIL CONTROL CALCULATIONS FOR LOAD CASE 1
#
```

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF 43.00 IS 1.7320

```
#
# BEGIN HOIL CONTROL CALCULATIONS FOR LOAD CASE 2
#
```

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF 43.00 IS 2.1650

```
EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
         12:12: 8 ON  9/17/80



#
# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#


DEFAULT VALUE OF    0.            USED FOR DELTA1(LC) (LOAD CASE  1)


 COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
    BACKFILL LAYER          KA VALUE
    ..............          ........
          1                  0.6049

         HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  1
         FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)


         OUTPUT OF ARRAYS HS, FHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

           ELEVATION  INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                          STATIC FORCE           EARTHQUAKE FORCE
              (FT)         (LBS/FT)                  (LBS/FT)
           ---------  ----------------------  ----------------------
          50.000            0.                        0.
          49.000            0.                        0.
          48.000            0.                        0.
          47.000            0.                        0.
          46.000            0.                        0.
          45.000            0.                        0.
          44.750            0.                        0.

         FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

         RESULTANT HORIZONTAL STATIC ACTIVE FORCE =        0.   LBS/HORIZ FT
         ACTING AT ELEVATION       0.

         RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
         DUE TO EARTHQUAKE =        0.    LBS/HORIZ FT
         ACTING AT ELEVATION       0.
```

```
EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
        12:12: 9 ON  9/17/80


#
# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#

DEFAULT VALUE OF    0.            USED FOR DELTA1(LC) (LOAD CASE  2)


 COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
    BACKFILL LAYER           KA VALUE
    ..............           ........
          1                   0.6049

        HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  2
        FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

        OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

         ELEVATION  INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                        STATIC FORCE            EARTHQUAKE FORCE
           (FT)          (LBS/FT)                (LBS/FT)
         ---------  ----------------------  ----------------------
         50.000           0.                      0.
         49.000           0.                      0.
         48.000           0.                      0.
         47.000           0.                      0.
         46.000           0.                      0.
         45.000           0.                      0.
         44.750           0.                      0.

        FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

        RESULTANT HORIZONTAL STATIC ACTIVE FORCE =        0.    LBS/HORIZ FT
        ACTING AT ELEVATION      0.

        RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
        DUE TO EARTHQUAKE =       0.    LBS/HORIZ FT
        ACTING AT ELEVATION      0.



#
# EXIT MODULE EA
#


 #
 # UPDATE FILE RESET
 #

 COMMAND ENTERED:
 RUN WA
```

```
EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
        12:16:37 ON  9/17/80

#
# BEGIN MODULE WA
#

DEFAULT VALUE OF    0.              USED FOR BASER      (LOAD CASE  1)

DEFAULT VALUE OF            0       USED FOR KFLAG      (LOAD CASE  1)

DEFAULT VALUE OF    0.              USED FOR DKEY       (LOAD CASE  1)

HEELW  CALCULATED TO BE      14.250

STR    CALCULATED TO BE     0.33000

SLOPE OF TOP OF HEEL SLAB =  57.00 H : 1 V (100.0:1 = LEVEL)


                COORDINATES OF CORNERS OF WALL CROSS-SECTION

          X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
          Y-COORDINATES ARE ELEVATIONS

     PT.     X          Y                   DESCRIPTION OF POINT
     --  --------  ----------    ----------------------------------------
      1     0.       65.0000     BASIC WORKING POINT = TOE-SIDE OF STEM TOP
      2     0.       44.8438     BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
      3     0.       44.8438     BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
      4   -8.2500    44.5000     TOP OF TOEHT = AT OUTER END OF TW2
      5   -8.2500    43.0000     TOE END OF BASE = AT BTE1
     10   16.7500    43.0000     HEEL END OF BASE
     11   16.7500    44.5000     TOP OF HEELT2 = TOP OF OUTER END OF HEEL
     12    2.5000    44.7500     BOTTOM OF HEEL-SIDE FACE OF STEM
     13    1.5000    65.0000     BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
     14    1.5000    65.0000     TOP OF HEEL-SIDE FACE OF STEM
     15   16.2500    43.0000     BOTTOM OF CUTOFF WALL UNDER KEY


WITH BASE RADIUS ("BASER", 0.0 FOR RECTANGULAR) =       0.    FEET,
TOE END OF BASE UNIT WIDTH =   1.0000 FT. AND
HEEL END OF BASE UNIT WIDTH =  1.0000 FT.
(BASIC WORKING POINT IS 1.0 FT. WIDE).


WALL DATA LISTS:

WLA     ETS              TW2             STR             HEELW
    65.00000         8.250000        0.3300000        14.25000

WLAB    BW               BS                              BASER (LIST=WLBR)
    25.00000       0.                              0.

WLAH  HEELT2          HEELW          HEELT1
    18.00000        14.25000       21.00000

WLAK  KFLAG              DKEY           WKEY            BKTF
        0          0.               0.            100.0000

WLAS   TSTT              TSH             TSTH           HSTPH          HSTPH
    18.00000       0.                30.00000       0.              0.
     HSBPH
   0.5925926
```

```
WLAT    HTEL             TOEHT            TS2            TW1             TS1
     45.00000        18.00000        24.00000        0.              100.0000

----  TMIOR            TMINS
   -0.12340000E 31 -0.12340000E 31


LOWEST CONCRETE =        43.00 FT.,  AT HEEL END OF BASE
COMPARED WITH THE PREVIOUS LOW OF  43.000000     FT.

  ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE   1 ----------

EH TOP CALCULATED TO BE       65.000
FOR LOAD CASE  1

> NPPO    IS           1

  ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE   2 ----------

EH TOP CALCULATED TO BE       62.000
FOR LOAD CASE  2

> NPPO    IS           1

  --------------- END OF PRESSURE DATA VERIFICATION ----------------

DEFAULT VALUE OF     3000.000      USED FOR   FPCON     (LOAD CASE  1)

DEFAULT VALUE OF   0.2900000E 08 USED FOR    FSTL     (LOAD CASE  1)

DEFAULT VALUE OF     9.190000      USED FOR   RATION    (LOAD CASE  1)

DEFAULT VALUE OF   0.3500000       USED FOR   RATIOF    (LOAD CASE  1)

DEFAULT VALUE OF    20000.00       USED FOR   FSTLMX    (LOAD CASE  1)

DEFAULT VALUE OF           0       USED FOR    IFDR     (LOAD CASE  1)

DEFAULT VALUE OF    3.500000       USED FOR   COVHS     (LOAD CASE  1)

DEFAULT VALUE OF    3.500000       USED FOR   COVTS     (LOAD CASE  1)

DEFAULT VALUE OF    3.500000       USED FOR   COVTB     (LOAD CASE  1)

DEFAULT VALUE OF    8.500000       USED FOR   COVBB     (LOAD CASE  1)

DEFAULT VALUE OF    2.370000       USED FOR   SPABL     (LOAD CASE  1)

COMBINED PASSIVE PRESSURE VALUE OF  -532.8674      USED FOR LOAD CASE  1

COMBINED PASSIVE PRESSURE VALUE OF  0.             USED FOR LOAD CASE  2



EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
          12:17:11 ON  9/17/80


#
# BEGIN STRESS ANALYSIS
#
```

EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
12:17:34 ON 9/17/80

#
BEGIN STEM STRESS ANALYSIS
#

SHEAR AT A DISTANCE D ABOVE THE BASE--

---------------- SECTION PROPERTIES AT ELEVATION 46.93 ----------------

MOM. SIGN	COMP. FACE WIDTH, IN.	OVERALL DEPTH IN.	EFFECTIVE DEPTH, IN.	REINFORCING AREA, SQ IN	TENSION FACE	K	J
+	12.00	28.71	25.21	2.00	HEEL		
-	12.00	28.71	25.21	0.44	TOE		

--- SHEAR ANALYSIS AT ELEVATION 46.93 (+ V FROM TOP PUSHED TOWARD TOE) ---

LOAD CASE	V LB / SLICE	N (COMP +) LB / SLICE	M LB-FT/SLICE	UNIT SHEAR STRESS PSI	ALLOWABLE UNIT STRESS	ACI318-77 PROVISION
1	9072.6	5276.1	61130.	29.990	60.803	8.7.4.5
2	4893.1	5276.1	33157.	16.170	60.803	8.7.4.5

MOMENT AT THE BASE--

---------------- SECTION PROPERTIES AT ELEVATION 44.84 ----------------

MOM. SIGN	COMP. FACE WIDTH, IN.	OVERALL DEPTH IN.	EFFECTIVE DEPTH, IN.	REINFORCING AREA, SQ IN	TENSION FACE	K	J
+	12.00	29.94	26.44	2.00	HEEL	0.287	0.904
-	12.00	29.94	26.44	0.44	TOE	0.147	0.951

FLEXURE ANALYSIS AT ELEVATION 44.84 (+ M = TENSION AT HEEL)

LOAD CASE	P (COMP=+) LB / SLICE	M LB-FT/SLICE	FC PSI	FS PSI
1	6040.	81420.	950.	18835.
2	6040.	43008.	587.	9946.

EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
12:17:52 ON 9/17/80

\#
\# BEGIN TOE STRESS ANALYSIS
\#

SHEAR AT A DISTANCE D FROM THE STEM--

----- SECTION PROPERTIES AT X = -1.333 (6.917 FEET FROM END OF TOE) -----

MOM. SIGN	COMP. FACE WIDTH, IN.	OVERALL DEPTH IN.	EFFECTIVE DEPTH, IN.	REINFORCING AREA, SQ IN	TENSION FACE	K	J
+	12.00	21.46	17.96	0.44	TOP		
-	12.00	21.46	16.96	2.00	BOTT		

--- SHEAR ANALYSIS AT X = -1.333 (6.917 FROM END OF TOE) (+ V = END DOWN) ---

LOAD CASE	V LB / SLICE	P (COMP +) LB / SLICE	M LB-FT/SLICE	UNIT SHEAR STRESS PSI	ALLOWABLE UNIT STRESS	ACI318-77 PROVISION
1	-7470.3	832.58	-27106.	36.709	60.366	8.7.4.5
2	-3044.0	-18.928	-10021.	19.381	60.232	8.7.4.3

MOMENT AT THE STEM (POINT 2)--

----- SECTION PROPERTIES AT X = -0.001 (8.249 FEET FROM END OF TOE) -----

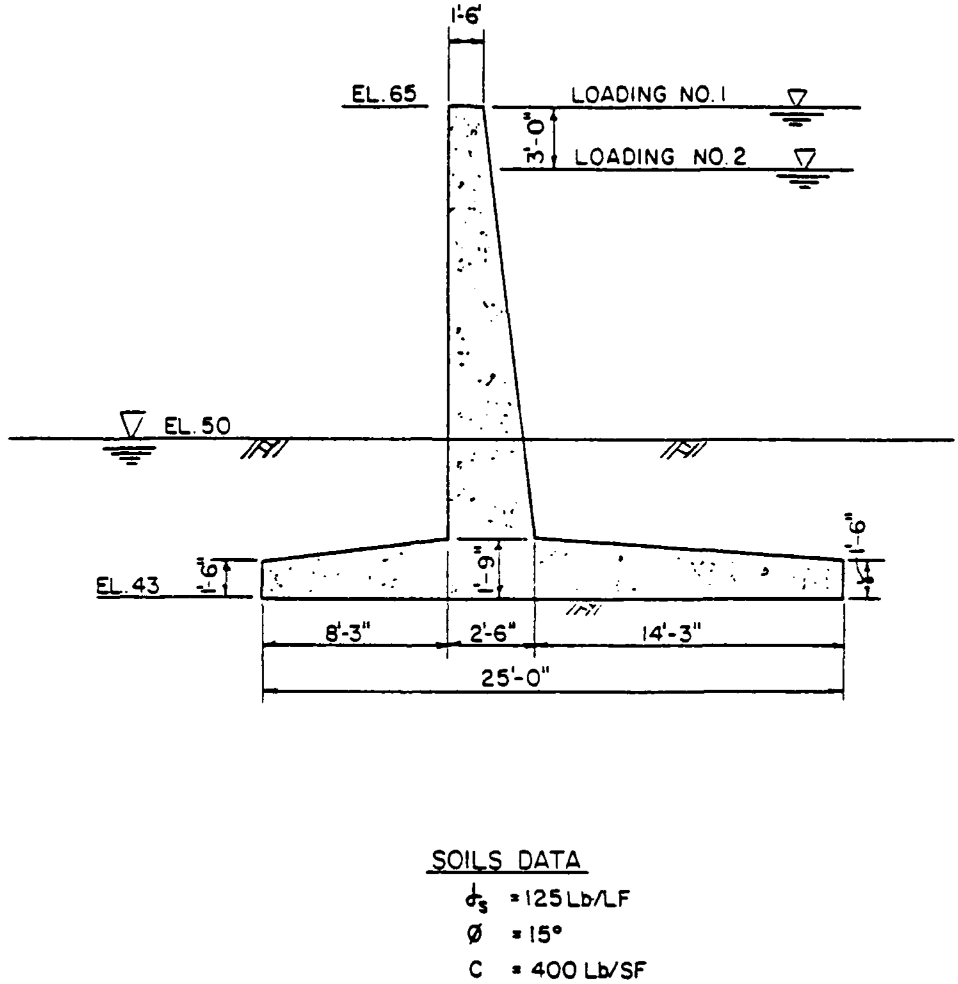
MOM. SIGN	COMP. FACE WIDTH, IN.	OVERALL DEPTH IN.	EFFECTIVE DEPTH, IN.	REINFORCING AREA, SQ IN	TENSION FACE	K	J
+	12.00	22.13	18.63	0.44	TOP	0.173	0.942
-	12.00	22.13	17.63	2.00	BOTT	0.339	0.887

FLEXURE ANALYSIS AT X = -0.001 (8.249 FROM END OF TOE) (+ M = TENSION IN TOP)

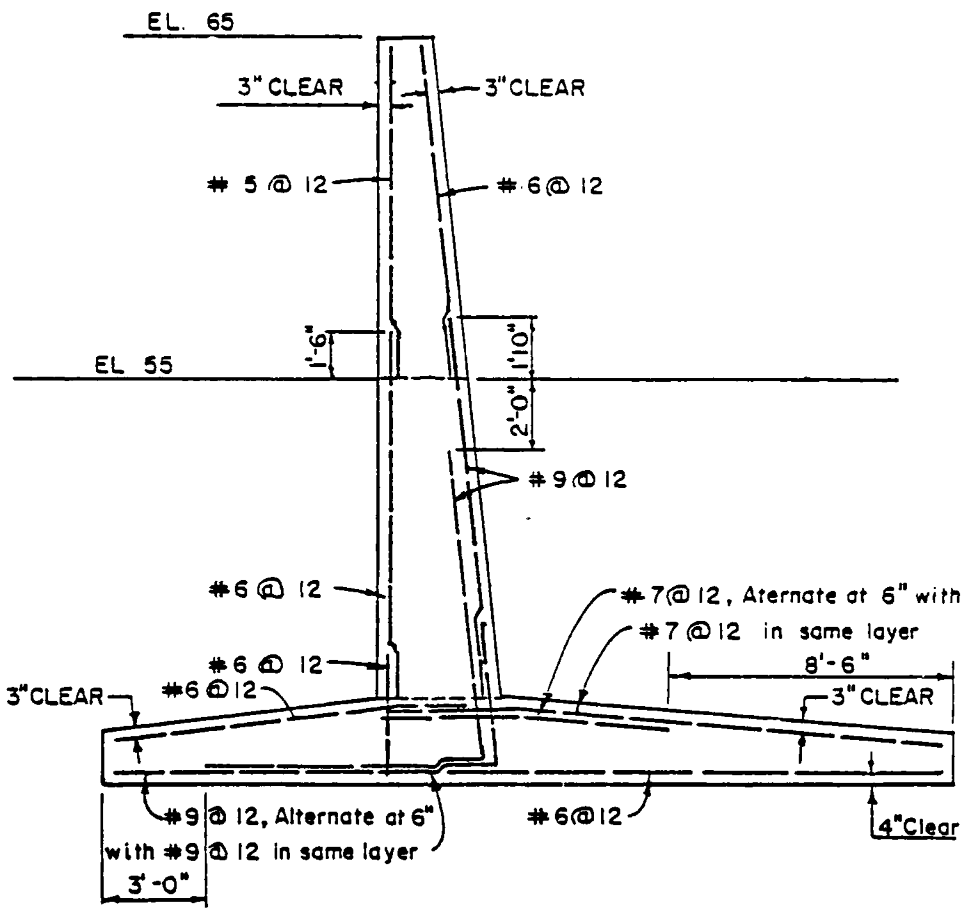
LOAD CASE	P (COMP=+) LB / SLICE	M LB-FT/SLICE	FC PSI	FS PSI
1	855.	-37032.	822.	14310.
2	-19.	-19808.	424.	7607.

```
EXAMPLE V2 -- BASIC FLOOD WALL ANALYSIS (USER GUIDE EX. 3)
        12:18: 7 ON  9/17/80

#
# BEGIN HEEL STRESS ANALYSIS
#

SHEAR AND MOMENT AT THE STEM--

----- SECTION PROPERTIES AT X =  2.501  (14.249 FEET FROM END OF HEEL) ----
MOM.  COMP. FACE   OVERALL    EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE      K       J
----  ----------  ---------  ----------  -----------  -------  -----   -----
 +       12.00      21.00       17.50        1.20        TOP   0.276   0.908
 -       12.00      21.00       16.50        0.44        BOTT  0.183   0.939

--- SHEAR ANALYSIS AT X =  2.501 (14.249 FROM END OF HEEL) (+V = END DOWN) ---
LOAD      V         N (COMP +)       M          UNIT SHEAR   ALLOWABLE   ACI318-77
CASE  LB / SLICE   LB / SLICE   LB-FT/SLICE   STRESS  PSI  UNIT STRESS PROVISION
----  ----------   ----------   -----------   -----------  ----------- ---------
 1     5658.0       801.85        45330.        26.943       60.365    8.7.4.5
 2     4383.9       57.966        33306.        20.876       60.258    8.7.4.5

FLEXURE ANALYSIS AT X =  2.501 (14.249 FROM END OF HEEL) (+M = TENSION IN TOP)
LOAD  N (COMP=+)        M         FC      FS
CASE  LB / SLICE  LB-FT/SLICE    PSI     PSI
----  ----------  -----------   -----  ------
 1        802.        45330.    1194.  28152.
 2         58.        33306.     869.  20932.

#
# MODULE WA COMPLETE
#

#
# UPDATE FILE RESET
#

COMMAND ENTERED:
END
```

3-5 <u>HAND CALCULATIONS.</u> These hand calculations were performed to the precision usually considered in field office design notes:

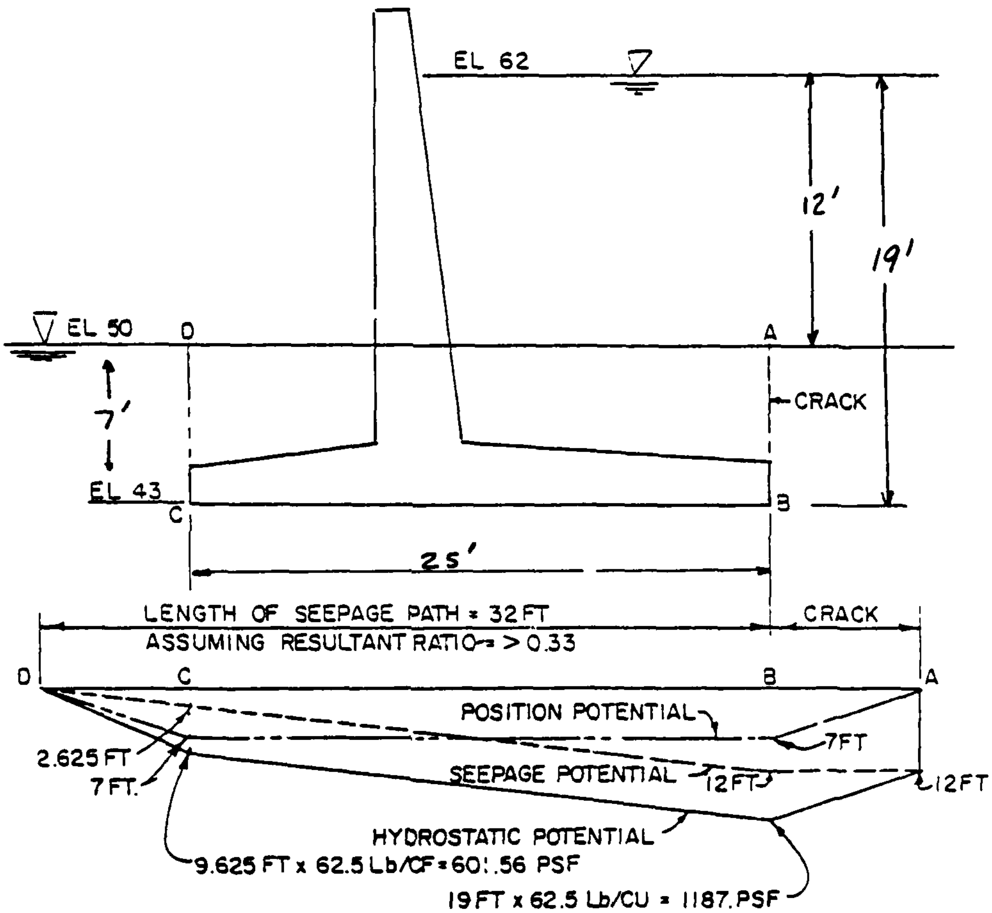


FLOODWALL ANALYSIS

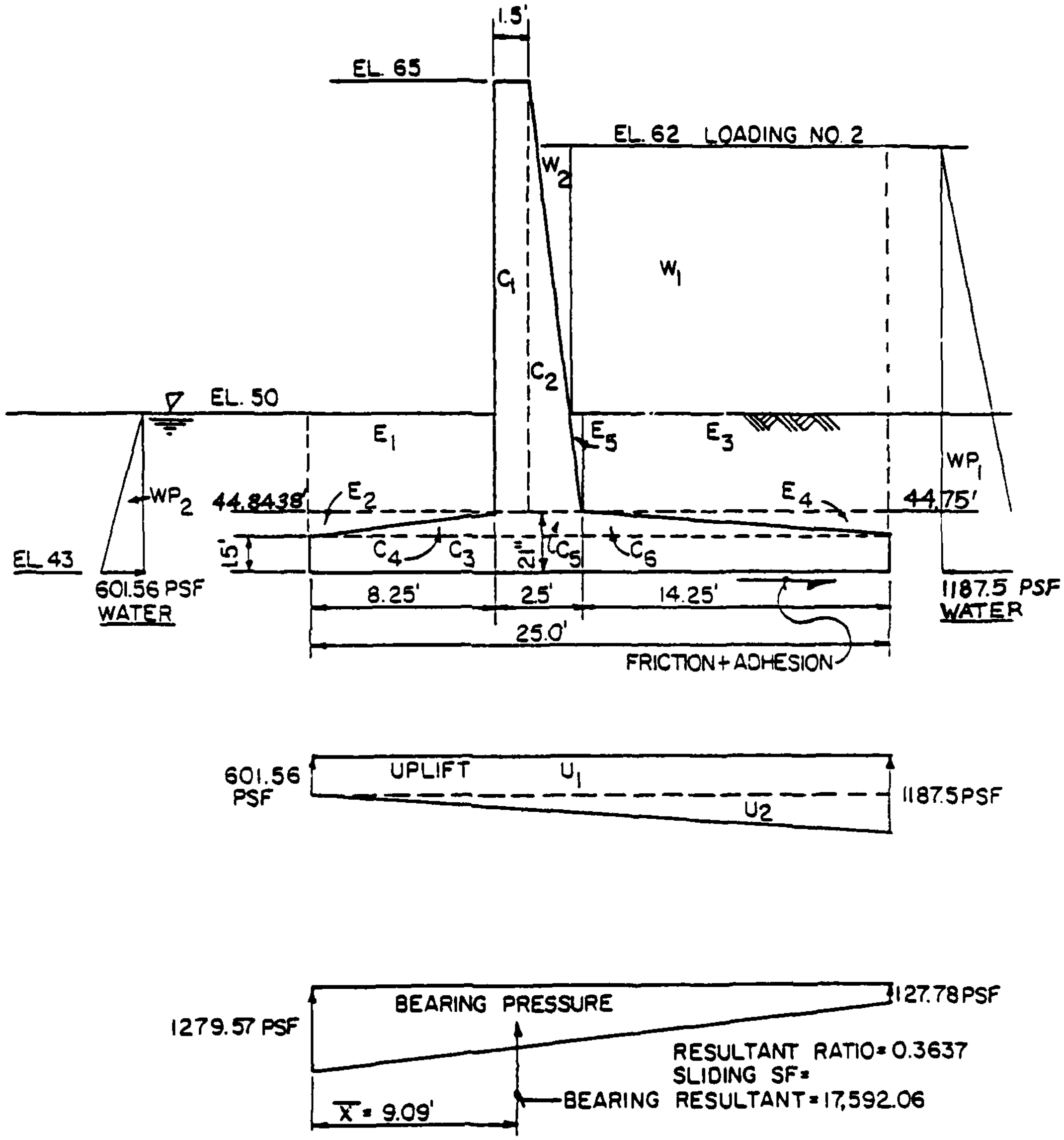


f_c = 3000 PSI
f'_c = 0.35 f_c = 1050 PSI (FOR HYDRAULIC STRUCTURF
f_y = 40,000 PSI
f = 20,000 PSI (FOR HYDRAULIC STRUCTURES)

WALL REINFORCEMENT



LOADING NO. 2-LINE OF CREEP



STABILITY LOADING NO. 2

LOADING No. 2 – OVERTURNING STABILITY								
PART	FACTORS	DIRECTION				ARM	MOMENTS	
		↓	↑	→	←		↷	↶
C_1	1.5X20.25X150	4556				9.0	41006	
C_2	1.0X20.5X0.5X150	1537				10.08	15498	
C_3	1.5X25.0X150	5625	12234			12.5	70312	
C_4	8.25X0.25X0.5X150	155				5.5	851	
C_5	2.5X0.25X150	94				10.0	938	
C_6	14.25X0.25X0.5X150	267				15.5	4141	
E_1	8.25X5.75X125	5930				4.13	24460	
E_2	8.25X0.25X0.5X125	129				2.75	355	
E_3	14.25X5.75X125	10242	16617			17.9	193079	
E_4	14.25X0.25X0.5X125	223				20.25	4509	
E_5	5.75X0.26X0.5X125	93				10.97	1015	
W_1	14.5X12X62.5	10883	11104			17.75	193,010	
W_2	12.0X0.59X0.5X62.5	221				9.95	2,201	
U_1	601.56X25		15039	22,360		12.5		187,998
U_2	585.94X25X0.5		7324			16.67		122,095
WP_1	1187.5X19X0.5				11,281	6.33		71,410
WP_2	601.56X7X0.5			2105		2.33	4906	
Σ		17592↓		9176			159,982 ↷	
FRICTION	17592 TAN 15°			4714		0		
ADHESION	25X400			10000		0		
PASSIVE	NONE REQUIRED							
Σ		17592↓		0			159,982 ↷	

BEARING PRESSURE RESULTANT = 17590 Lb/LF ↑

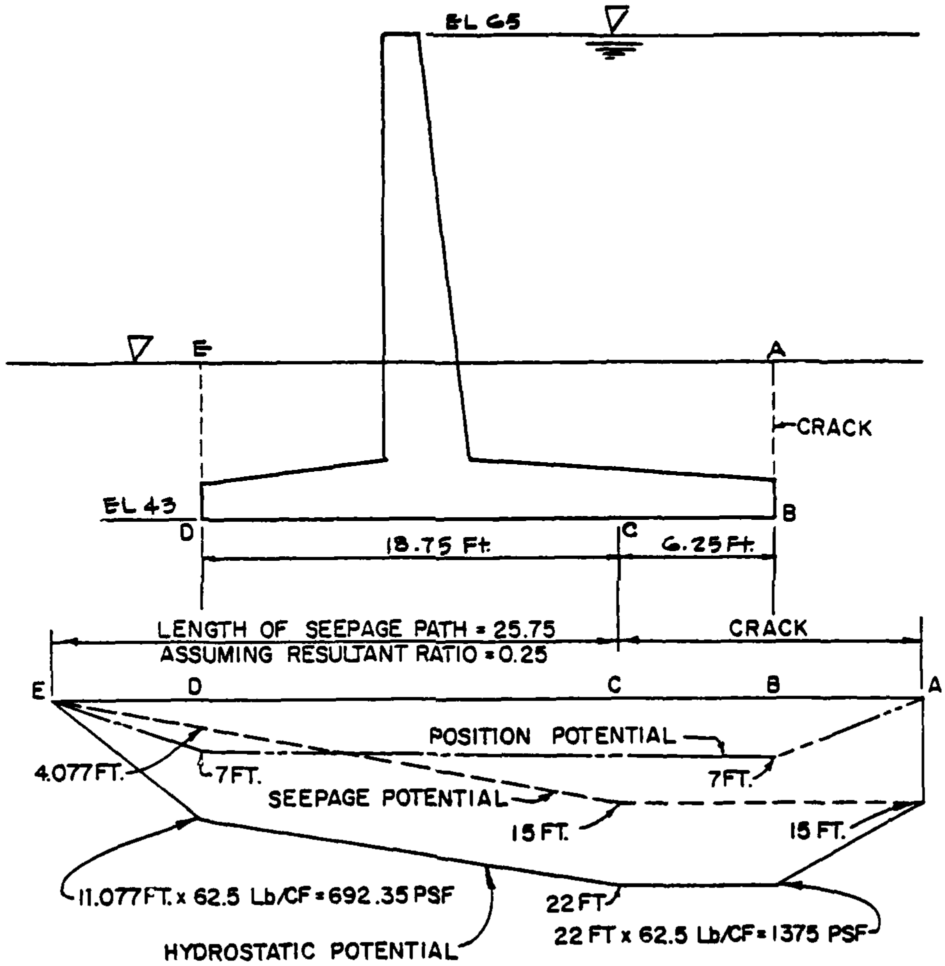
RESULTANT LOCATION = $\bar{X}$ = $\frac{159,990}{17590}$ = 9.09 FT FROM END TOE

RESULTANT RATIO = $\frac{9.09}{25}$ = 0.364

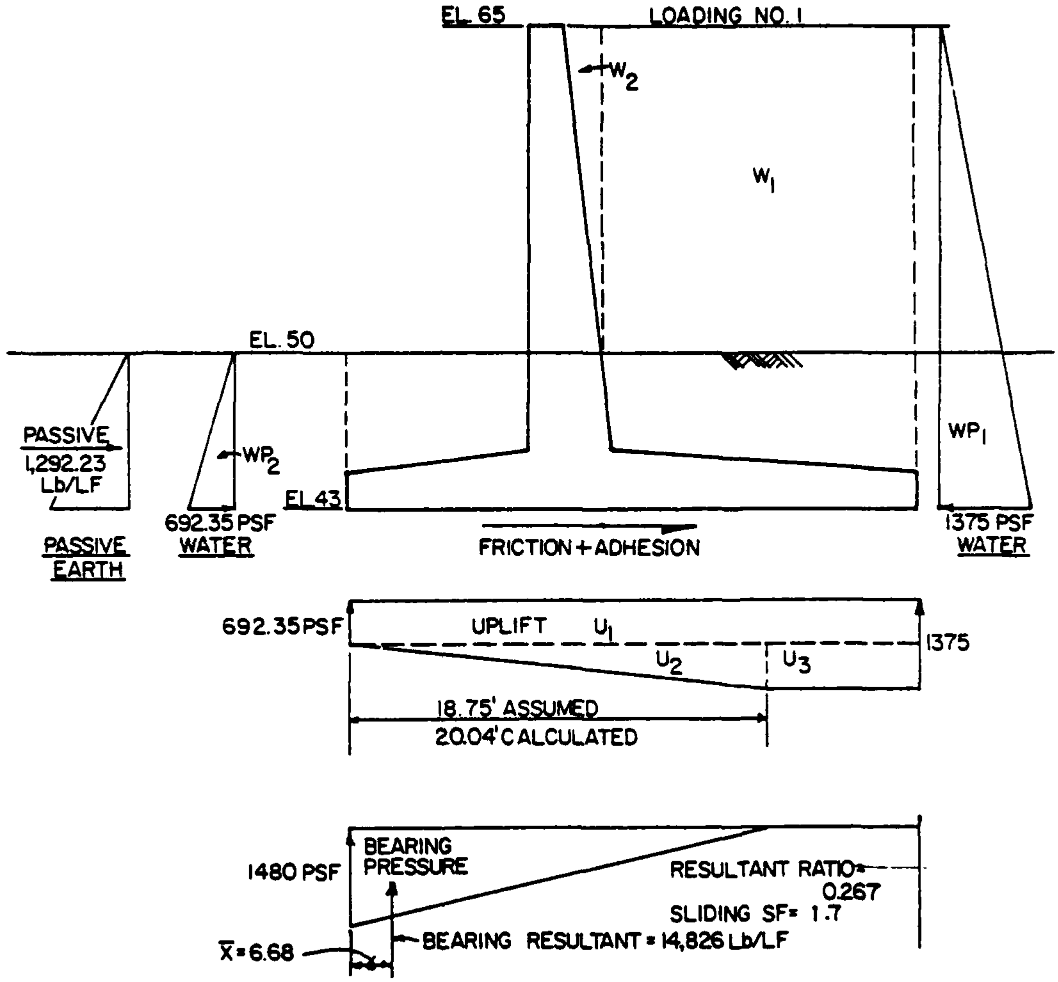
BEARING PRESSURE = $\frac{\Sigma V}{BW}\left(1 \pm \frac{6e}{L}\right) = \frac{17,590}{25}\left(1 \pm \frac{6 \times 3.41}{25}\right)$

BEARING PRESSURE AT END HEEL = 127.8 PSF

BEARING PRESSURE AT END TOE = 1,279.6 PSF



LOADING NO. 1 LINE OF CREEP



STABILITY LOADING NO. 1

LOADING NO. 1 - OVERTURNING STABILITY

PART	FACTORS	DIRECTION ↓	↑	→	←	ARM	MOMENTS ↻	↺
ΣC	—	12234				—	132746	
ΣE	—	16616				—	213,417	
W_1	14.51X15X62.5	13603				17.75	241,397	
W_2	0.74X15X0.5X62.5	347				10.24	3,553	
U_1	692.35×25		17,309			12.5		216,361
U_2	692.65×18.75×0.5		6400			12.5		79,998
U_3	692.65×6.25		4266			21.99		93,331
WP_1	1375X22X0.5				15,125	7.33		110 966
WP_2	692.35×7×0.5			-2423		2.33	5646	
Σ		14826 ↓		12702 ←			96 257 ↻	
FRICTION	14826 X TAN 15°			3973		0		
ADHESION	400X18.75			7500		0		
PASSIVE				1229		2.33	2864	
Σ		14826 ↓					99121 ↻	

BEARING PRESSURE RESULTANT = 14926 ↑

RESULTANT LOCATION = $\bar{x} = \frac{99121}{14826}$ = 6.68 FT FROM END OF TOE

RESULTANT RATIO = $\frac{6.68}{25}$ = 0.267

BEARING PRESSURE = $\frac{14826(2)}{3(6.68)}$ = 1480 PSF AT END OF TOE

BEARING PRESSURE = 0 - LOCATED 3(6.68)=20.04 FT FROM END TOE

Re-compute Neutral Block Weight for Load Case 2

Item	factors	Force
E1	$8.25(50-44.8438)(125)$	5317
E2	$8.25(44.8438-44.5)(0.5)(125)$	177
E3	$14.25(50-44.75)(125)$	9352
E4	$14.25(44.75-44.5)(0.5)(125)$	223
E5	$(50.0-44.75)\left(1.0\,\frac{50-44.75}{65-44.75}\right)(0.5)(125)$	85
		15154
W1	$(62-50)(14.25+0.259)\ 62.5$	10882
W2	$(62-50)(14.25+1.0-14.51)\ 0.5(62.5)$	277
		11159
	subtotal	26313
	concrete	12234
		38547

SLIDING FACTOR OF SAFETY

Allowable Strength Factor of Safety Definition. Equate the driving and resisting forces acting on the wall by applying the factor of safety (F.S.) to the soil shear strengths in accordance with the following relationships:

ϕ = Angle of internal friction of soil
ϕ' = Developed angle of internal friction
C = Cohesive strength of soil
C' = Developed cohesive strength of soil

$$\tan\phi' = \frac{\tan\phi}{F.S.}$$

$$C' = \frac{C}{2q+F.S.}; \text{ where } q = C' \text{ in tons/ft}^2$$

General Solution Procedure for Hand Computations.

(1) Assume trial failure surface.
(2) Assume F.S. for trial failure surface.
(3) Solve for developed ϕ' and C'.
(4) Calculate developed resisting forces on wall = FRICTION + ADHESION + PASSIVE FORCE.
(5) Compare developed resisting forces to actual driving forces; if they are equal, the assumed F.S. is correct for assumed failure surface.
(6) Repeat Steps (2) thru (5) for all possible failure surfaces.
(7) The actual F.S. is the lowest value obtained from all trial failure surfaces.

LOADING NO. 2 - SLIDING ANALYSIS

BECAUSE WALL HAS LEVEL BASE AND NO KEY THE CRITICAL FAILURE SURFACE IS LOCATED ALONG THE BASE.

ASSUME SLIDING F.S. = 2.7

$$TAN\,\phi' = \frac{TAN\,\phi}{F.S.} = \frac{TAN\,15^{\circ}}{F.S.} = 0.09924$$

$$\boxed{\phi' = 5.67^{\circ}}$$

$$C' = \frac{C}{2q + F.S.} = \frac{C}{\frac{2C'}{2000} + F.S.}$$

$$(C')^2 + 1000(F.S.)C' - 1000(C) = 0$$

$$(C')^2 + 1000(2.7)C' - 1000(400) = 0$$

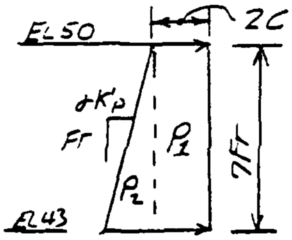
$$\boxed{C' = 136.9\ PSF}$$

ADHESION ALONG BASE = C'(BW) = 136.8(25) = 3420.25 LB/LF

FRICTION ON BASE = TAN ϕ'(EV) = 0.09924(17,592.06) = 1,745.34 LB/LF

PASSIVE FORCE ON PROTECTED SIDE

2C' = 2(136.9) = 273.6 PSF



$$K'p = TAN^2(45 + \tfrac{\phi'}{2}) = TAN^2(45 + \tfrac{5.67}{2}) = 1.22$$

$$\gamma K'p = (125 - 62.5)(1.22) = 76.25\ LB/FT^2$$

$$P_1 = 273.6(7) = 1915.9$$

$$P_2 = \frac{76.25(7)^2}{2} = 1868.1$$

$$\boxed{TOTAL\ PASSIVE = 3784\ LB/LF}$$

RESISTING FORCE DEVELOPED = ADHESION + FRICTION + PASSIVE

RESISTING FORCE DEVELOPED = 8,950 LB/LF

DRIVING FORCE ON WALL = $W P_1 - W P_2$ = 9,176 LB/LF

$$\boxed{\text{SINCE DRIVING FORCE} \cong \text{RESISTING FORCE, ACTUAL F.S.} \cong 2.7}$$

LOADING No. 1 - SLIDING ANALYSIS

BECAUSE WALL HAS LEVEL BASE AND NO KEY THE CRITICAL FAILURE SURFACE IS LOCATED ALONG THE BASE.

ASSUME SLIDING F.S. = 1.7

$TAN\ \Phi' = \frac{TAN\ 15^\circ}{1.7} = 0.157617$

$\boxed{\Phi' = 8.96^\circ}$

$(C')^2 + 1000(1.7)C' - 1000(400) = 0$

$\boxed{C' = 282.1\ Lb/FT^2}$

ADHESION ALONG BASE = C'(EFFECTIVE BASE) = 282.1(20) = 5642 Lb/LF

FRICTION ON BASE = $TAN\ \Phi'(\Sigma V)$ = 0.157617(14,826) = 2337 Lb/LF

PASSIVE FORCE ON PROTECTED SIDE

$K'p = TAN^2(45 + \frac{\Phi'}{2}) = TAN^2(45 + \frac{8.96}{2}) = 1.37$

$\gamma K_p' = (125 - 62.5)(1.37) = 85.6\ Lb/FT^3$

$P_1 = 282.1(7) = 1974.7$

$P_2 = \frac{85.6(7)^2}{2} = 2097.2$

$\boxed{TOTAL\ PASSIVE = 4072\ Lb/LF}$

RESISTING FORCE DEVELOPED = 12,051 Lb/LF

DRIVING FORCE ON WALL = $WP_1 - WP_2$ = 12,702 Lb/LF

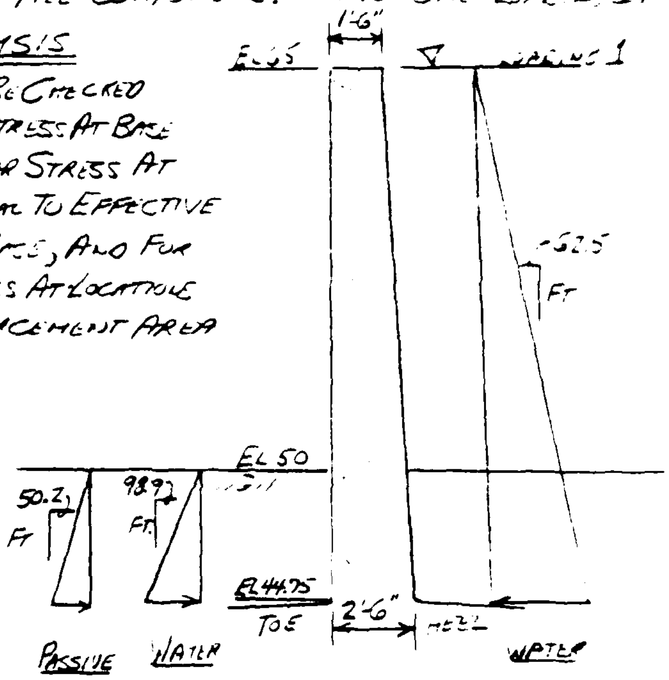
$\boxed{\text{SINCE DRIVING FORCE} \cong \text{RESISTING FORCE, ACTUAL F.S} \cong 1.7}$

Stress Analysis Of Wall Components

By Inspection Loading No 1 Will Produce The Maximum Stresses In All Components. - Check Only Loading No 1.

Stem Analysis

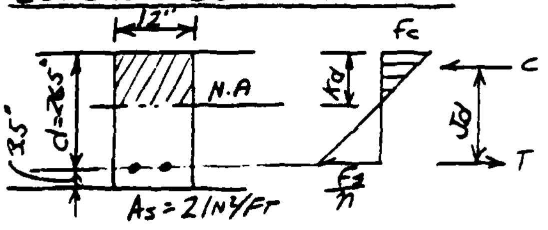
Stem Should Be Checked For Flexural Stress At Base Of Stem, Shear Stress At Distance Equal To Effective Depth Above Base, And For Flexural Stress At Locations Where Reinforcement Area Changes.



Moment At Base Of Wall (El 44.75)

$$M = \frac{(20.25)^3(62.5)}{6} - \frac{(5.25)^3(50.2+98.9)}{6} = 82,902 \text{ Ft-Lb/Ft}$$

Concrete Section At Base



$E_s = 29,000,000 \text{ psi}$

$E_c = W_c^{1.5}(33)\sqrt{F'_c}$

$E_c = (150)^{1.5}(33)\sqrt{3000}$

$E_c = 3,320,56$[illegible]

$n = \frac{E_s}{E_c} = 8.73$

LOCATE NEUTRAL AXIS

$12(kd)\left(\frac{kd}{2}\right) = 8.73(2)(26.5-kd)$

$6\,kd + 17.46\,kd - 462.69 = 0$

$kd = 7.45\ IN$

DETERMINE CONCRETE AND STEEL STRESS

$Jd = d - \frac{kd}{3} = 26.5 - \frac{7.446}{3} = 24.02$

$T = C = \frac{M}{Jd} = \frac{82,902(12)}{24.02} = 41,421\ Lb$

STEEL STRESS

$$\boxed{f_s = \frac{T}{A_s} = \frac{41,421}{2} = 20,711\ PSI}$$

CONCRETE STRESS

$$\boxed{f_c = \frac{2C}{b(kd)} = \frac{2(41,421)}{12(7.446)} = 927\ PSI}$$

SHEAR AT A DISTANCE $d = 26.5''$ ABOVE BASE (EL 46.96)

$V = \frac{625(19.04)^2}{2} - \frac{(50.2+98.9)(3.04)^2}{2} = 9,481\ Lb/LF$

DETERMINE UNIT SHEAR STRESS

d AT EL $46.96 = 25.25\ IN$

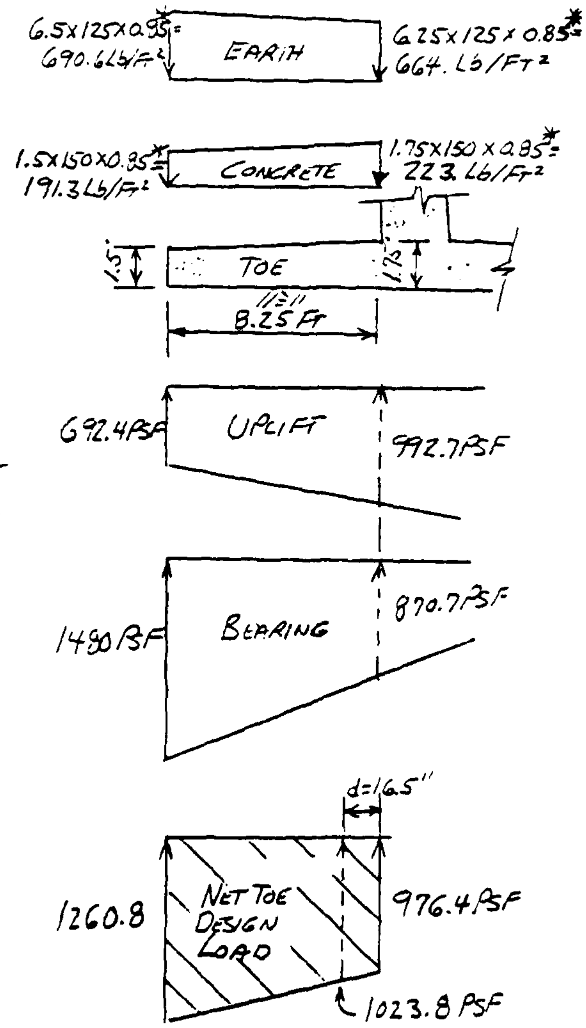
$$\boxed{v = \frac{V}{bd} = \frac{9481}{12(25.25)} = 31.3\ PSI}$$

FLEXURAL STRESS AT CHANGE IN STEM REINFORCEMENT

FLEXURAL STRESS SHOULD BE CHECKED AT A DISTANCE BELOW THE ACTUAL BAR CUT-OFF LOCATION TO SATISFY ACI CODE REQUIREMENTS FOR BAR EXTENSION BEYOND POINT WHERE THE BAR AREA IS NO LONGER REQUIRED FOR MOMENT. THESE FLEXURAL COMPUTATIONS WILL NOT BE SHOWN BECAUSE THEY ARE SIMILAR TO THOSE ALREADY PRESENTED.

TOE ANALYSIS

TOE SHOULD BE CHECKED FOR FLEXURAL STRESS AT FACE OF STEM, SHEAR STRESS AT DISTANCE EQUAL TO EFFECTIVE DEPTH FROM FACE OF STEM, AND FOR FLEXURAL STRESS AT LOCATION WHERE REINFORCEMENT AREA CHANGES.



* MULTIPLY THE EARTH AND CONCRETE DEAD LOADS BY 0.85 BECAUSE THEY DECREASE THE EFFECTS OF LIVE LOADS. SEE ACI 318-77 PAR B.2.3

MOMENT AT FACE OF STEM

$$M = \frac{976.4(8.25)^2}{2} + \frac{284.4(8.25)^2}{3}$$

$M = 39{,}671.$ Ft-Lb/Ft

CONCRETE SECTION AT STEM

$A_s = 2\ IN^2$

$d = 21'' - 4.5'' = 16.5''$

LOCATE NEUTRAL AXIS

$$12(Kd)\left(\frac{Kd}{2}\right) = 8.73(2)(16.5 - Kd)$$

$$6Kd^2 + 17.4Kd - 288.09 = 0$$

$Kd = 5.62$ IN.

DETERMINE CONCRETE AND STEEL STRESS

$Jd = d - \frac{Kd}{3} = 16.5 - \frac{5.62}{3} = 14.63$ IN

$T = C = \frac{M}{Jd} = \frac{39,671(12)}{14.63} = 32,539$ Lb

STEEL STRESS

$$\boxed{f_s = \frac{T}{A_s} = \frac{32,539}{2.0} = 16,270 \text{ PSI}}$$

CONCRETE STRESS

$$\boxed{f_c = \frac{2C}{b(Kd)} = \frac{2(32539)}{12(5.62)} = 965 \text{ PSI}}$$

SHEAR AT A DISTANCE d = 16.5" FROM FACE STEM

$V = 1023.8(6.875) + \frac{237(6.875)}{2} = 7853.3$ Lb/LF

$d = 20.5 - 4.5 = 16.0"$

$$\boxed{v = \frac{V}{bd} = \frac{7853}{(12)(16)} = 40.9 \text{ PSI}}$$

HEEL ANALYSIS DISCUSSION

THE HEEL SHOULD BE CHECKED FOR FLEXURAL STRESSES AT FACE OF STEM AND AT LOCATIONS WHERE REINFORCEMENT AREA CHANGES.

SHEAR SHOULD BE CHECKED AT THE FACE OF STEM BECAUSE THE REACTION OF THE MEMBERS DOES NOT INDUCE COMPRESSION IN THE END REGION OF MEMBERS AT STEM AS REQUIRED BY ACI 318-77 PAR 11.1.3.

NOTE: USE FULL EARTH AND DEAD LOAD ON HEEL BECAUSE THESE LOADS DO NOT DECREASE THE EFFECTS OF LIVE LOADS.

THESE CALCULATIONS ARE SIMILAR TO OTHERS WHICH HAVE BEEN SHOWN AND THEY WILL NOT BE INCLUDED HERE.

3-6 COMPARISONS OF RESULTS.

3-6-1 Load Case 1 Stability Summary. Note that the resultant is outside the kern, with full hydrostatic pressure extending underneath the base to the point of zero bearing pressure:

Item	Program	Hand Calculation	Difference	Percent of Hand
Resultant ratio	0.24	0.267	-0.027	10.1
Sliding factor of safety	1.73	1.7	0.03	1.8
Bearing pressure, psf				
Toe end	1,447	1,480	-33	2.3
0.0 at X =	9.93'	11.97'	1.79'	--*
Weight of neutral block	41,377	42,800	-1423	3.3

* This is an iterative process. The program iterates an uplift until the change in X is less than 0.01 ft. The hand calculations were not this accurate. See the calculations where the base width portion in contact with the subgrade was assumed to be 18.75 ft and calculated to be 20.04 ft, a difference of 1.29 ft. This is comparable to the 1.79-ft difference in this comparison.

3-6-2 Load Case 2 Stability Summary. The base is in contact with the subgrade over the full width:

Item	Program	Hand Calculation	Difference	Percent of Hand
Resultant ratio	0.3611	0.364	-0.003	0.8
Sliding factor of safety	2.68	2.7	-0.02	0.7
Bearing pressure, psf				
Toe end	1,152	1,279	-127.6	9.97
Heel end	104.8	127.8	-23	18.0
Weight of neutral block	38,073	39,955**	-1882	4.7
		38,547†	-474	1.2
Bearing pressure force	15,713	17,590	-1878	10.7
Uplift force	22,363	22,363	0	0

** Original computation.

† Recomputed value.

The (creep method) uplift force compares exactly, as it has for all other comparisons not shown in this report. The only significant difference is in the bearing pressure force. The difference becomes acceptable when the recomputed value is used, since the difference in original bearing force is a result of the difference in weight of the neutral block.

3-6-3 <u>Structural Analysis from Load Case 1:</u>

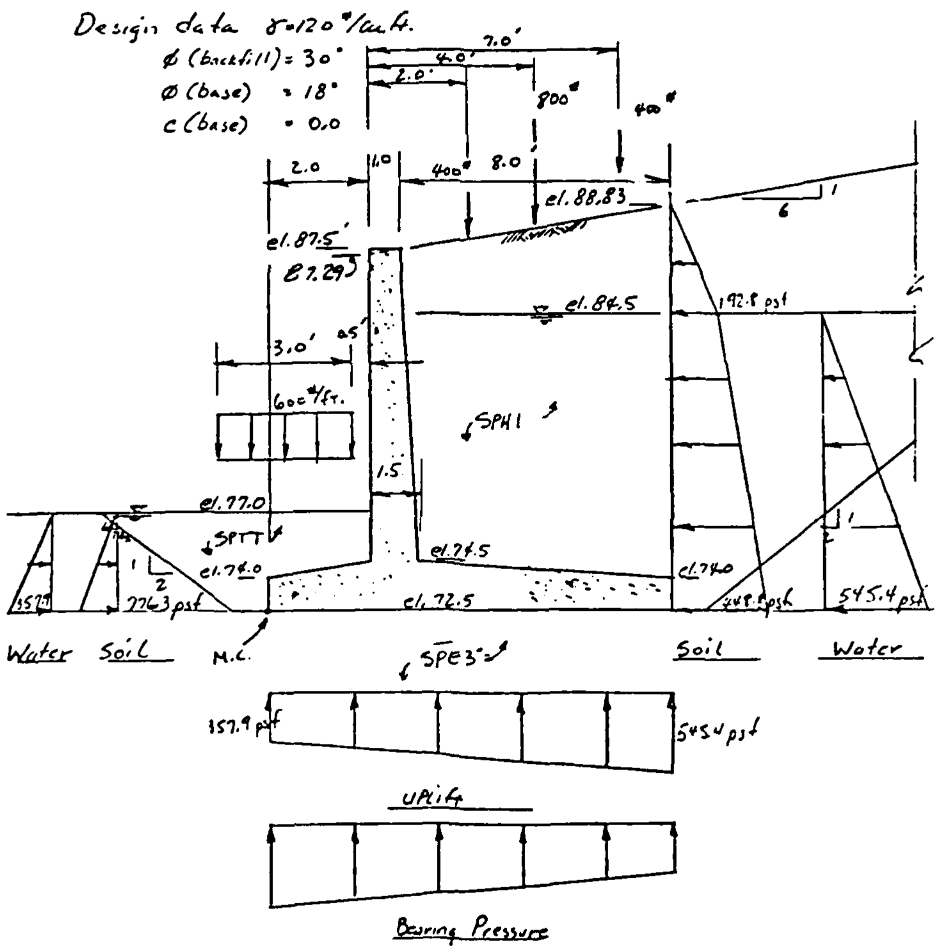
Item	Program	Hand Calculation	Difference	Percent of Hand
Stem moment at base	81,328	82,902	-1574	1.9
Stem moment at base				
f_s, psi	18,835	20,711	-1876	9.1
f_c, psi	959	927	32	3.5
Shear at el 46.93				
Force, lb/ft	9,073	9,841	-408	4.3
Unit stress, psi	30	31.3	1.3	4.2
n (E_s/E_c)	9.19	8.73		
k_d, in.	0.287 (26.44) = 7.59	7.45	0.14	1.9
Stem axial force at base	6,040	0	6040	--

The significantly lower steel stress from the program is expected from the fact that the 6040-lb/ft axial compression is neglected in the hand calculations. The concrete stress is greater, as expected.

4-1 DESCRIPTION OF PROBLEM. This problem is the same as load cases 3 and 4 for Example A in the User's Reference Manual. The example deals with an analysis of a complex retaining wall. Load case 4 differs from load case 3 in that it has concentrated and distributed surcharges. These are the only load cases from the example which are activated. The only comparisons are for the surcharges because the other calculations are performed by the parts of the program that are verified in Problems V1 and V2:

Extreme Operating Condition

CASE III STRUCTURE Complete, backfill in place, Collector system clogged, water in backfill to elev. 84.5, backfill on passive side submerged, surcharge loads over toe and heel.



Reinforcing steel = 0.89 %, in each face, all members

4-2 **DATA PREPARATION.** Paragraph references are to the User's Reference Manual:

STARTING SEQUENCE DATA, paragraph 2-5-2:

* INIT = Start of fresh run

* 1 = 1 load case

* R = Retaining wall default values wanted:

list name	variable name	page number	default values flood wall	default values retaining wall
SEEP	KRACK	3-8	1 (yes)	2 (no)
SLID	NSLIDE	3-9	2	1
"	FSMIN	3-9	1.5	2.0
SOLP	NPPD	3-15	1(δ)	3(Δ)

* H = hydraulic structure default values wanted - see paragraph 7 2

* NAME ANALYSIS OF COMPLEX RET WALL

Use data list CASE to designate the one load case as case no. 3, to match the problem description:

* CASE 1 3

BACKFILL SOILS PROPERTIES DATA, para 12-3-2

a. Soils over toe — Data list SPT7 is needed because the properties are different from those in the subgrade.

list name	LC	PHI7 ϕ	COH7 C, psf	GAMAS7 γ_s pcf
* SPT7	0	30.0	0.0	120.0

b. The soil at the end of the toe is the same as the soil over the toe, so data list SPT6 is not needed.

c. Soil Over heel – Data list SPH1 is needed because the properties are different from those in the subgrade.

	list name	LC	PHI1 ϕ	COH1 psf	GAMAS1 γ_s pcf	RKA1 K_a	DELTA1 δ	RKAE1 K_{ae}	HCMIN ft.
*	SPH1	0	30.0	0.0	120.0	C	0.0	C	C

Only one layer, so data lists SPH2 and SPHF are not used.

With all of these being C or default value, this last part of the list may be truncated.

BACKFILL FINISHED SOIL SURFACE DATA, para 12-3-3

a. Over toe

	list name	LC	ESTW ft.	SST 1:x
*	SST	0	77.0	100.0

level

b. Over heel: (Coulomb method)

	list name	LC	ESHW ft.	HS3 1:x
*	SSHC	0	87.29	6.0

EXISTING SOIL PROPERTIES, para 12-3-4

Data list SPE3 is required. With only one layer of subgrade soil, data lists SPE4 and SPES are not needed. Since no allowable bearing pressures are specified, omit that part of the list:

	list name	PHI3 ϕ	COH3 psf	GAMAS3 γ_s, pcf	PHIS3 ϕ sliding	ADHS3 adhesion psf
*	SPE3	18.0	0.0	120.0	18.0	0.0

omit ABP3TN ABP3BN ABP3TW ABP3BW ELBS3

EXISTING SOIL SURFACE DATA, para 12-3-5

Data list SSEE is not needed for an analysis problem. While it could be used, its data are not specified.

FOUNDATION DESIGN PARAMETERS, para. 12-3-6

With a pure retaining wall, all of the retaining wall default values and procedures are acceptable. So, none of these lists are needed:

ONEA, RRD, SLZO, SOLP

SURCHARGES AND DIRECT LOADS, para 12-3-7

Vertical forces on backfill are in data list SCFV:

	list name	LC	PV1 lb/ft	DV1 ft	PV2 lb/ft	DV2 ft	PV3 lb/ft	DV3 ft
★	SCFV	3	400.0	2.0	800.0	4.0	400.0	7.0

PV4, DV4, PV5, DV5 are not needed, so are omitted, #

Vertical area loads on backfill are in list SCWV:

	list name	LC	WT psf	WWT ft	DWT ft	WH psf	WWH ft	DWH ft
★	SCWV	3	600.0	3.0	0.5	C	C	C

with all values = C, the last part of this list may be omitted #

SEEPAGE AND BOIL CONTROL, para 12-3-8

a. Water levels and seepage calculation control

	list name	LC	ELWT ft.	ELWH ft	HGSW	ISLC	ISFT	KRACK
★	SEEP	3	77.0	84.5	D=0.0	D=1	D=1	D

"NO", since this is a retaining wall

with all values = default, rest of list is not needed #

b. Boil control criteria not specified, so not used

\# = but could have been included as "D" or "C", as appropriate

WALL GEOMETRY, para 12-3-9

Calculated from BW − TW2 − $\frac{TSTB}{12}$

list name	ETS ft.	TW2 ft.	STR ratio	HEELW ft.
* WLA	87.5	2.0	C	C

list name	BW ft.	BW1	BW2	BS slope
* WLAB	11.0	10.0	12.0	0.0

With allowable bearing pressures not to be calculated, BW1 & BW2 are immaterial, but they must not be equal and BW must be BW1 ≠ BW ≠ BW2

list name	TSTT in.	TSB in/ft	TSTB in	HSTPH ft.	HSTPB in/ft	HSBPB in/ft
* WLAS	12.0	0.0	18.0	0.0	0.0	C

Check TSTT for compliance with TMINS default limitation: (paragraph 3-6-2 b(2)):

ETS − BTE1 = 87.5 − 72.5 = 15.0, default = 12", so OK

with default for TMINS ≤ TSTT, list WLDS is not needed.

list name	BTE1 ft.	TOEHT in.	TS2	TW1 ft.	TS1
* WLAT	72.5	18.0	100.0	0.0	100.0

With no key, list WLAK is not needed.

list name	HEELT2 in	HEELW	HEELT1 in
WLAH	18.0	C	24.0

ADD'L DATA FOR STRUCTURAL ANALYSIS, para 12-3-10

All of the default values in data lists CND, CNWD, and COVR are acceptable, so the lists are not needed.

Reinforcing Steel, para 12-3-11

Stem:

list name	LOC	ASTLST(LOC) $\boxed{11}$/1	LN	ASTLSH (LOC, LN) $\boxed{11}$/1
* STLS	1	0.89	1	0.89

top

toe:

list name	LOC	LNA	ASTLBT (LOC, LNA) $\boxed{11}$/1	LNB	ASTLBB (LOC, LNB) $\boxed{11}$/1
* STLB	1	1	0.89	1	0.89

end

heel: LOC at outer end: BW+1.9999 = 11+1.9999
= 12.9999
use LOC = 12 @ end

list name	LOC	LNA	ASTLBT (LOC, LNA)	LNB	ASTLBB (LOC, LNB)
* STLB	12	1	0.89	1	0.89

Put into data list form, with line numbers.

DATA FILE:

```
*LIST EX'3DAT

1000 INIT
1010 2
1020 R
1030 H
1040 NAME  ANALYSIS OF COMPLEX RETAINING WALL
1050 CASE 2 3 4
2000 SPT7  0  30.0  0.0  120.0
2010 SPHW  0  30.0  0.0  120.0
3000 SST   0  77.0  100.0
3010 SSHC  0  87.29  6.0
4000 SPE3  18.0  0.0  120.0  18.0  0.0
5000 SCFV  4  400.0  2.0  800.0  4.0   400.0  7.0
5010 SCWV  4  600.0  3.0  0.5
6000 SEEP  3  77.0  84.5
6010 SEEP  4  77.0  84.5
7000 WLA  87.5  2.0  C  C
7010 WLAB  11.0  10.0  12.0  0.0
7020 WLAS  12 0  0.0  18.0  0.0  0.0  C
7030 WLAT  72.5  18.0  100.0  0.0  100.0
7040 WLAH  18.0  C  24.0
8000 STLS  1  0.89  1  0.89
8010 STLB  1  1  0.89  1  0.89
8020 STLB  12  1  0.89 . 1  0.89
9000 UPDATE
```

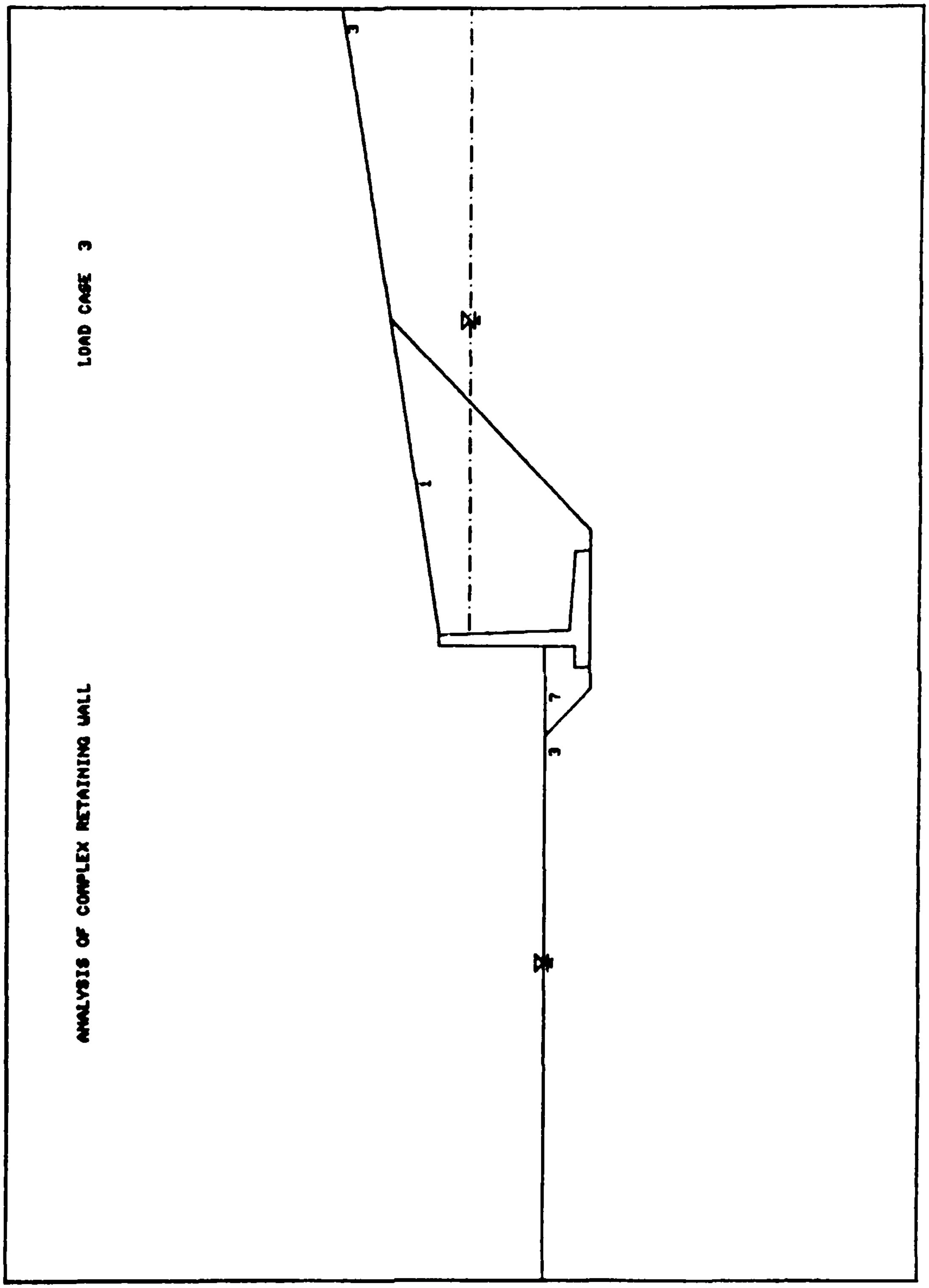
4-3 <u>TIME-SHARING TERMINAL INPUT/OUTPUT.</u> Note the use of the TRCE 1 command:

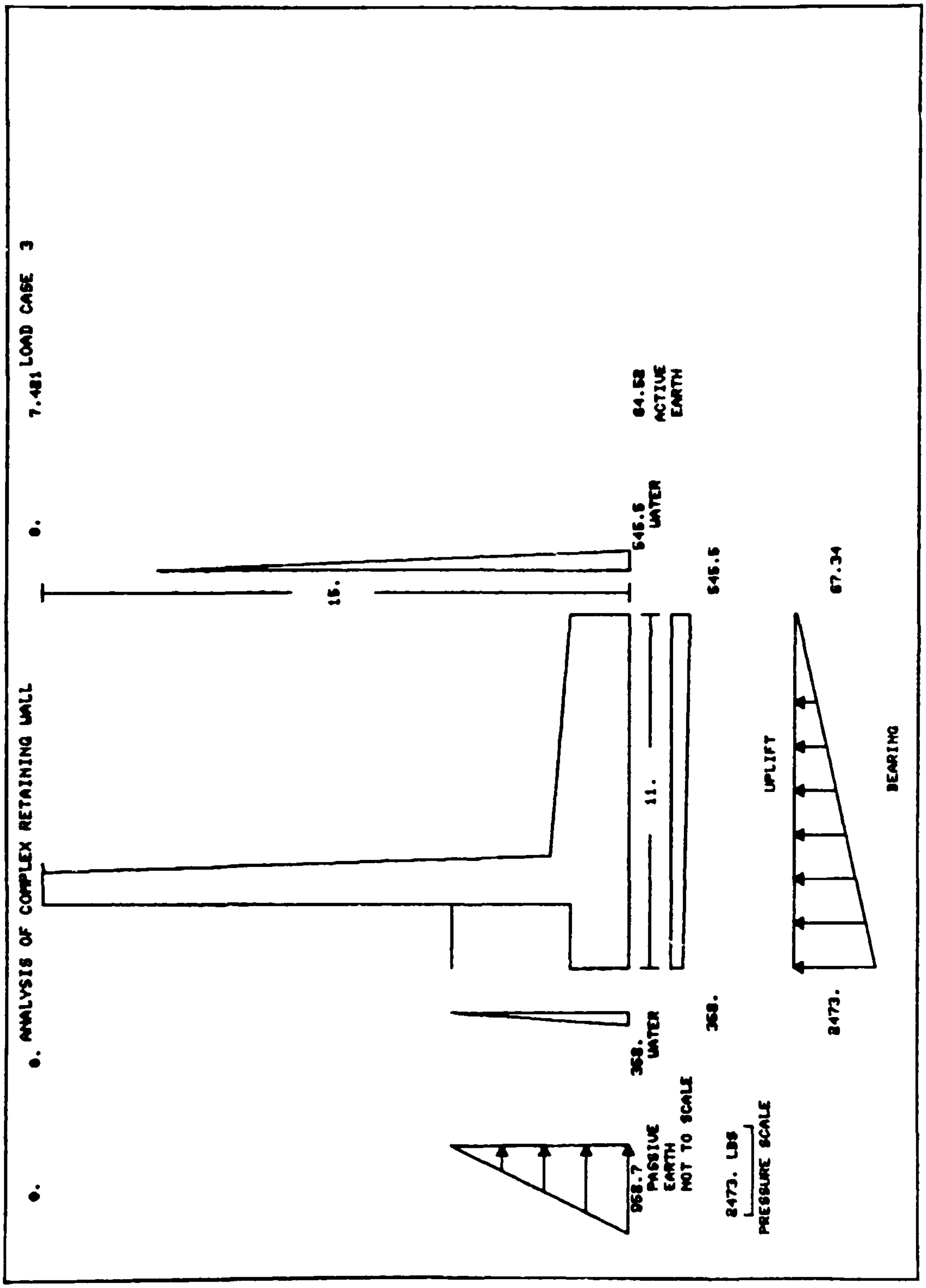
```
*FORTRAN
*RUN WESLIB/TWDA,R

          10/02/80    11.159


PROGRAM TWDA -- 713-F3-R0 0E7
   T-WALL DESIGN/ANALYSIS
       REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EXV3UPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?W.A.PRICE
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?EXV3DAT
PROCESSING DATA FILE...

NOT ENOUGH VALUES ENTERED IN DATA LIST - SPH1
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST - SPE3
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST - SCFV
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST - SCWV
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'

$
$ UPDATE FILE RESET
$

$
$ DATA FILE PROCESSING DONE
$
```

```
$ RETURN TO INTERACTIVE INPUT
$

COMMAND
?TRCE 1

COMMAND
?RUN FA

        11:12:45 ON 10/ 2/80

        11:12:45 ON 10/ 2/80

        11:12:46 ON 10/ 2/80

        11:12:47 ON 10/ 2/80

        11:12:49 ON 10/ 2/80

        11:12:53 ON 10/ 2/80

THE RESULTANT RATIO =      0.3422, FOR LOAD CASE  3

THE RESULTANT RATIO =      0.3541, FOR LOAD CASE  4

        11:12:55 ON 10/ 2/80

FINAL FACTOR OF SAFETY AGAINST SLIDING =     0.94, FOR LOAD CASE  3
BY SHEAR FRICTION METHOD

FINAL FACTOR OF SAFETY AGAINST SLIDING =     1.01, FOR LOAD CASE  4
BY SHEAR FRICTION METHOD

        11:12:57 ON 10/ 2/80

        11:12:57 ON 10/ 2/80

TOTAL CONCRETE VOLUME =        35.38 (CU FT / LF), FOR LOAD CASE  3

TOTAL CONCRETE VOLUME =        35.38 (CU FT / LF), FOR LOAD CASE  4

        11:12:59 ON 10/ 2/80

        11:13: 2 ON 10/ 2/80

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
        (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD.)
   OR 0 TO OMIT THE PLOTS
?1
```

```
$ RETURN TO INTERACTIVE INPUT
$

COMMAND
?TRCE 1

COMMAND
?RUN FA

          11:12:45 ON 10/ 2/80

          11:12:46 ON 10/ 2/80

          11:12:46 ON 10/ 2/80

          11:12:47 ON 10/ 2/80

          11:12:49 ON 10/ 2/80

          11:12:53 ON 10/ 2/80

THE RESULTANT RATIO =      0.3422, FOR LOAD CASE  3

THE RESULTANT RATIO =      0.3541, FOR LOAD CASE  4

          11:12:55 ON 10/ 2/80

FINAL FACTOR OF SAFETY AGAINST SLIDING =     0.94, FOR LOAD CASE  3
BY SHEAR FRICTION METHOD

FINAL FACTOR OF SAFETY AGAINST SLIDING =     1.01, FOR LOAD CASE  4
BY SHEAR FRICTION METHOD

          11:12:57 ON 10/ 2/80

          11:12:57 ON 10/ 2/80

TOTAL CONCRETE VOLUME =         35.38 (CU FT / LF), FOR LOAD CASE  3

TOTAL CONCRETE VOLUME =         35.38 (CU FT / LF), FOR LOAD CASE  4

          11:12:59 ON 10/ 2/80

          11:13: 2 ON 10/ 2/80

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
         (MAKE HARD COPY BEFORE CARRIAGE RETURN)
         (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD.)
   OR 0 TO OMIT THE PLOTS
?1

          11:13:49 ON 10/ 2/80
```

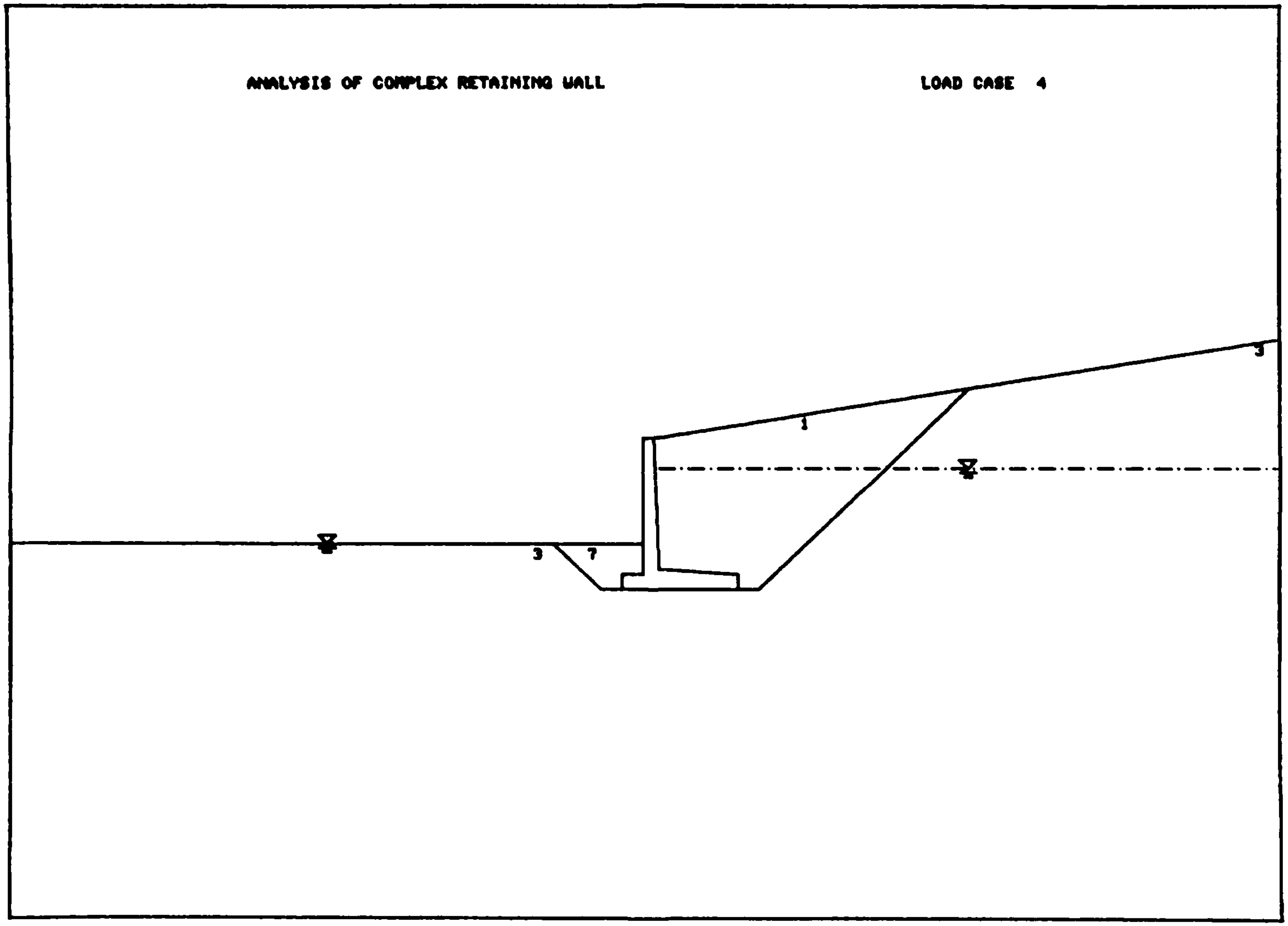
```
NOTE --- A BELL WILL RING AT SELECTED TIMES
         TO ALLOW YOU TO MAKE A HARDCOPY IF
         YOU SO DESIRE. TO RESUME EXECUTION
         SIMPLY ENTER A CARRIAGE RETURN

ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      * TO TERMINATE GRAPHICS
?1
ACTIVE LOAD CASES
****** **** *****
               3
               4
ENTER DESIRED ACTIVE LOADCASE
      OR AN * TO RETURN
?3
```

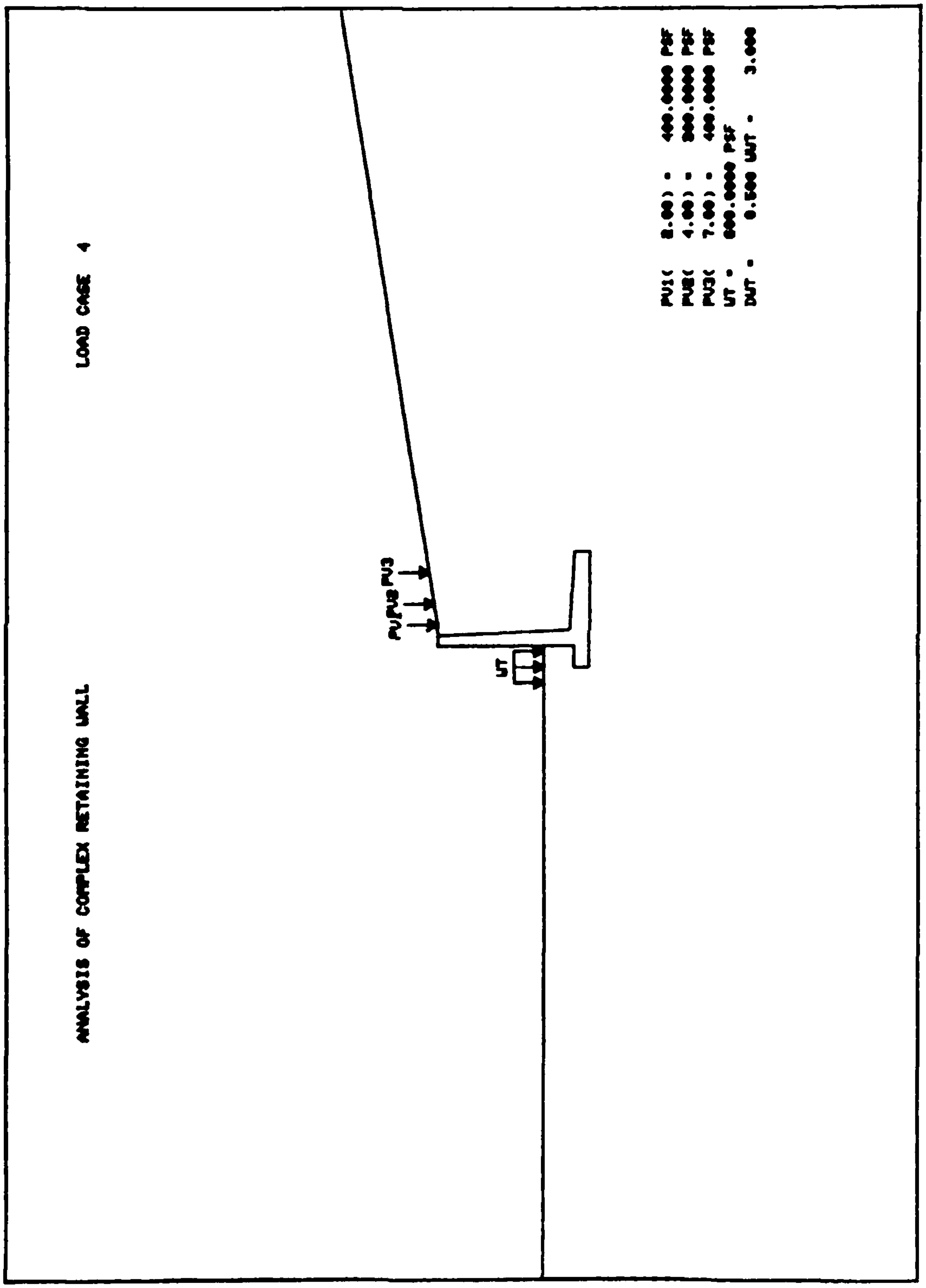

ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 3

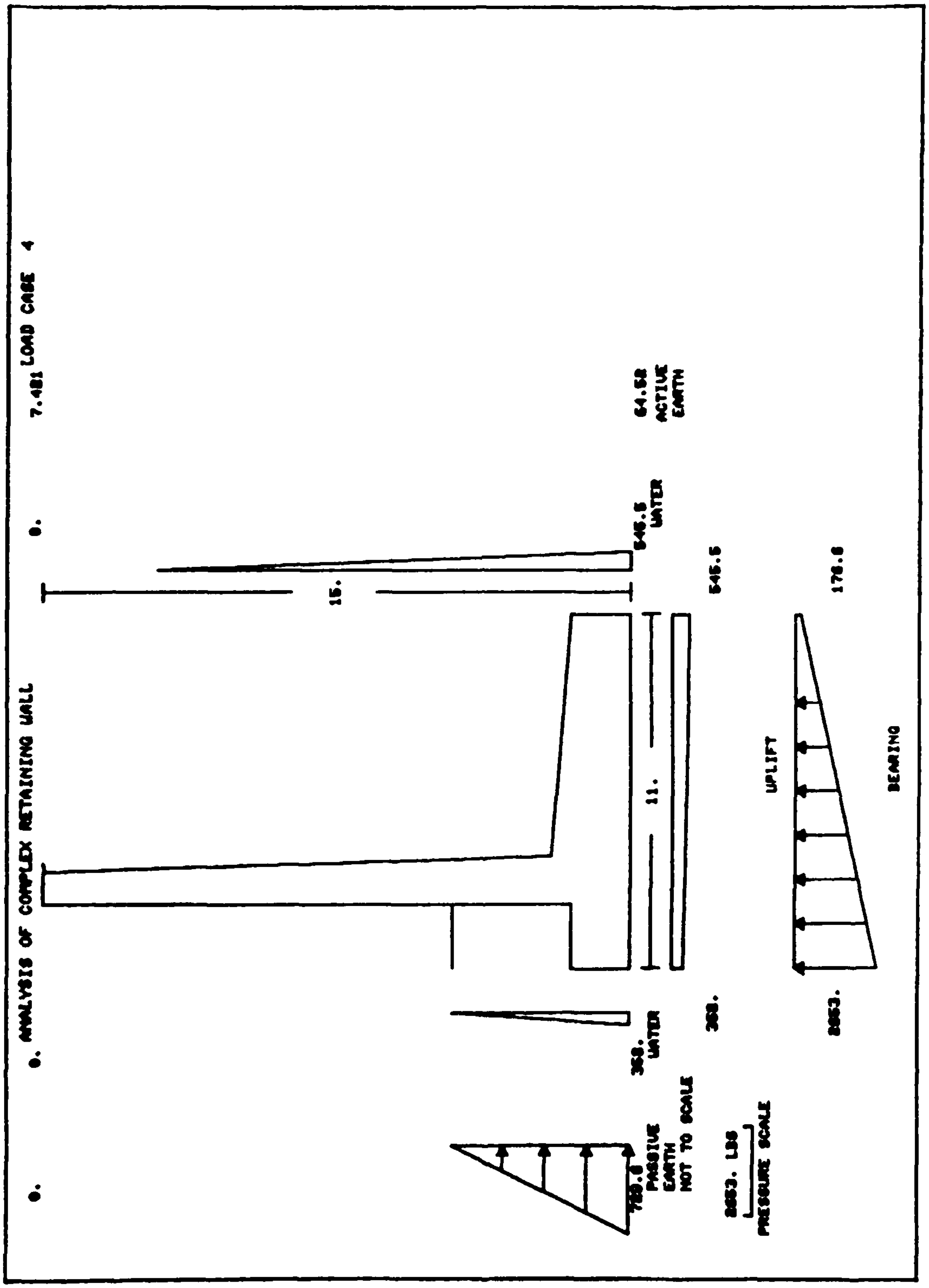


0. ANALYSIS OF COMPLEX RETAINING WALL
7.481 LOAD CASE 3
0.
0.
15.
11.
545.6 WATER
64.58 ACTIVE EARTH
545.6
67.34
UPLIFT
BEARING
368. WATER
368.
2473.
958.7 PASSIVE EARTH NOT TO SCALE
2473. LBS
PRESSURE SCALE

```
ACTIVE LOAD CASES
****** **** *****
                3
                4
ENTER DESIRED ACTIVE LOADCASE
      OR AN X TO RETURN
?4
```

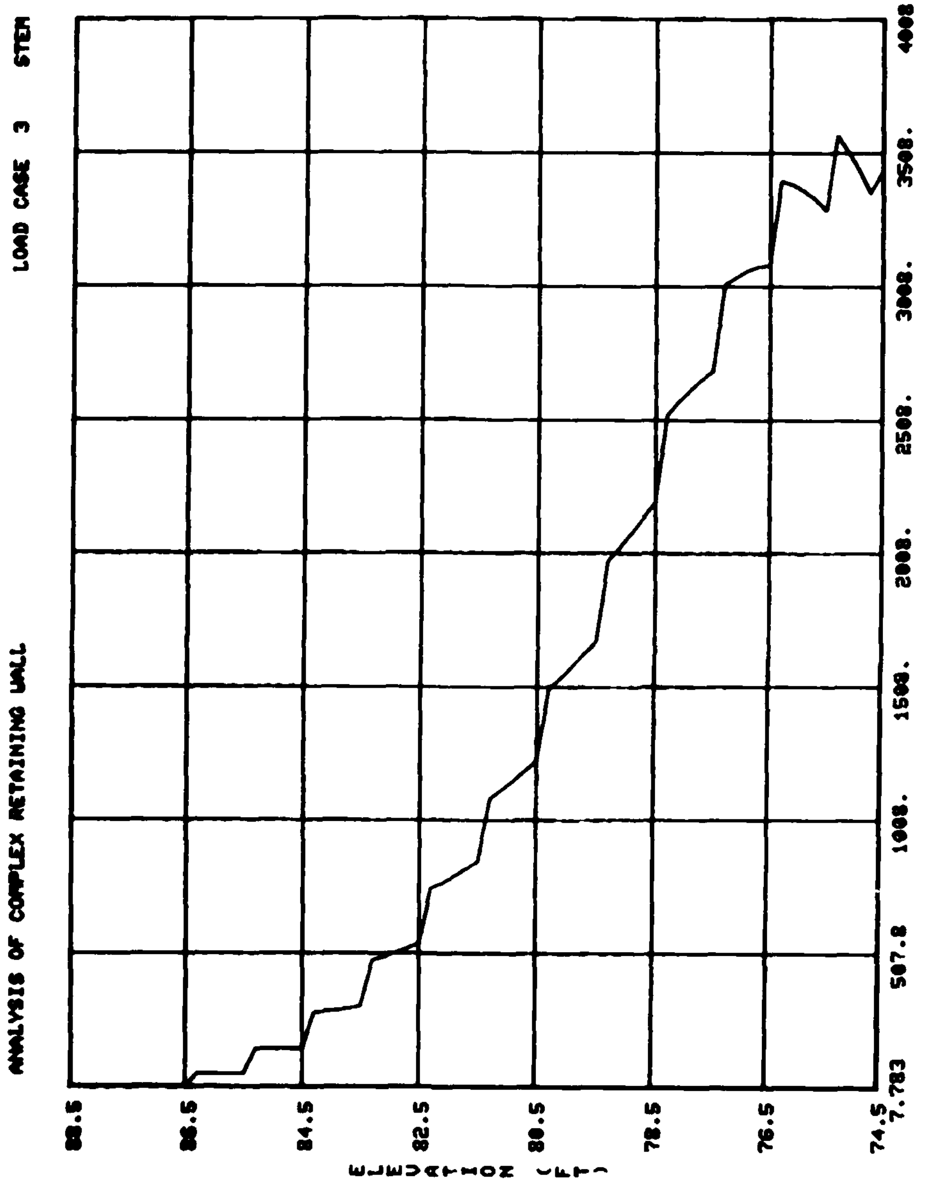

ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 4
1
3
3
7

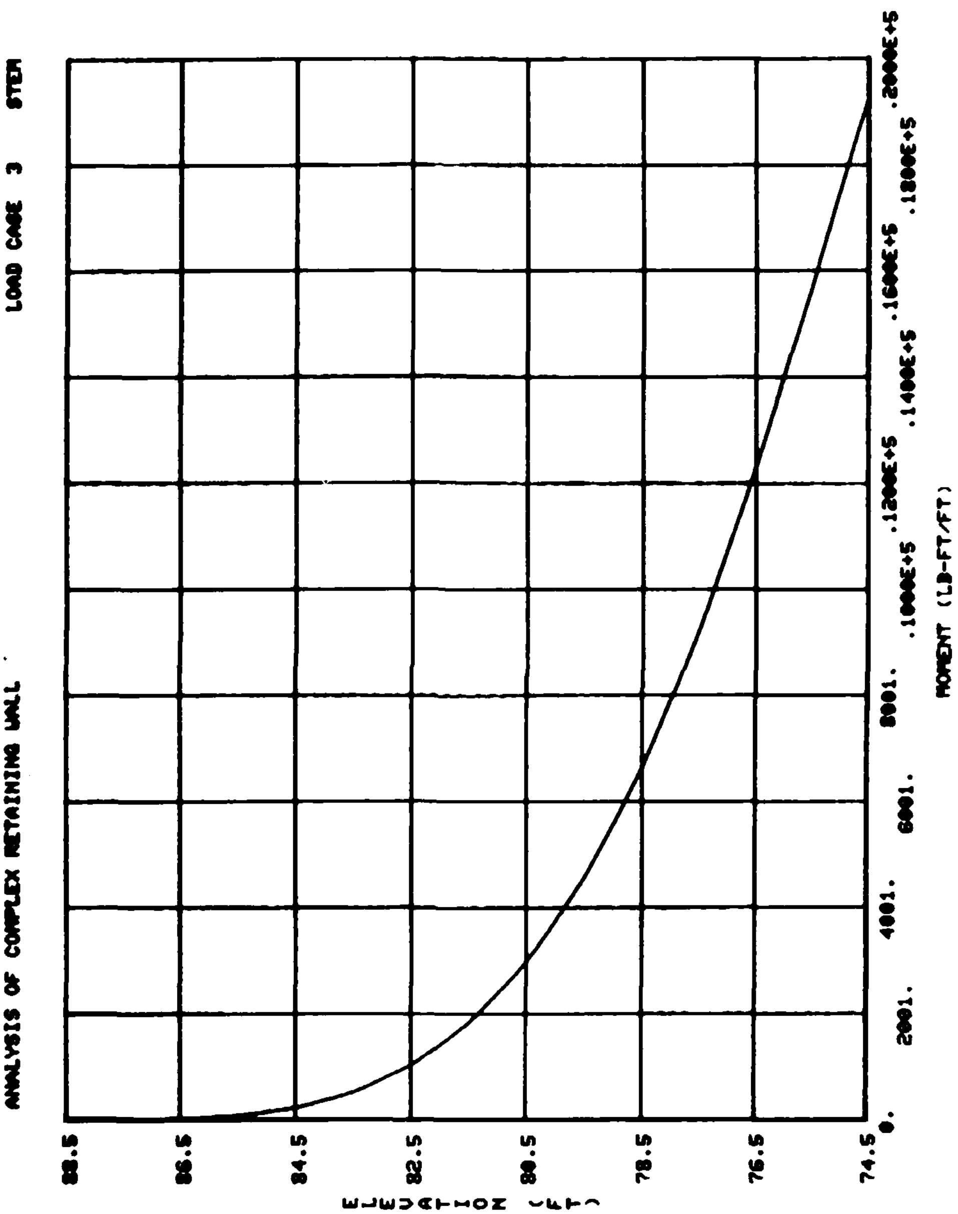

ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 4
PU1 PU2 PU3
UT
PU1(2.00) = 400.0000 PSF
PU2(4.00) = 300.0000 PSF
PU3(7.00) = 400.0000 PSF
UT = 800.0000 PSF
DUT = 0.500 UWT = 3.000


0. ANALYSIS OF COMPLEX RETAINING WALL
7.481 LOAD CASE 4
0.
64.52
ACTIVE
EARTH
546.5
WATER
15.
546.5
176.6
11.
UPLIFT
BEARING
368.
WATER
368.
2863.
0.
PASSIVE
EARTH
NOT TO SCALE
2863. LBS
PRESSURE SCALE

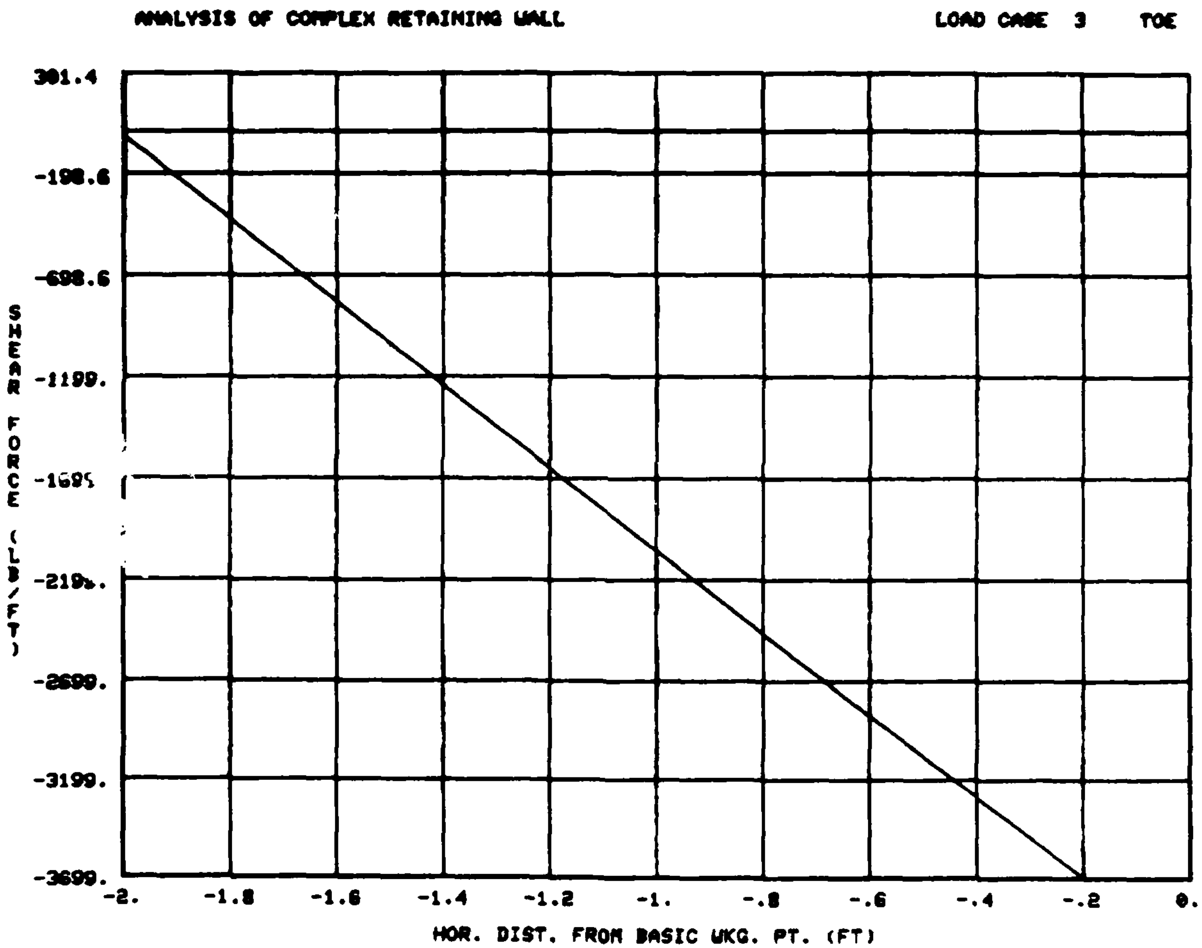
```
ACTIVE LOAD CASES
****** **** *****
                3
                4
ENTER DESIRED ACTIVE LOADCASE
      OR AN * TO RETURN
?*
```

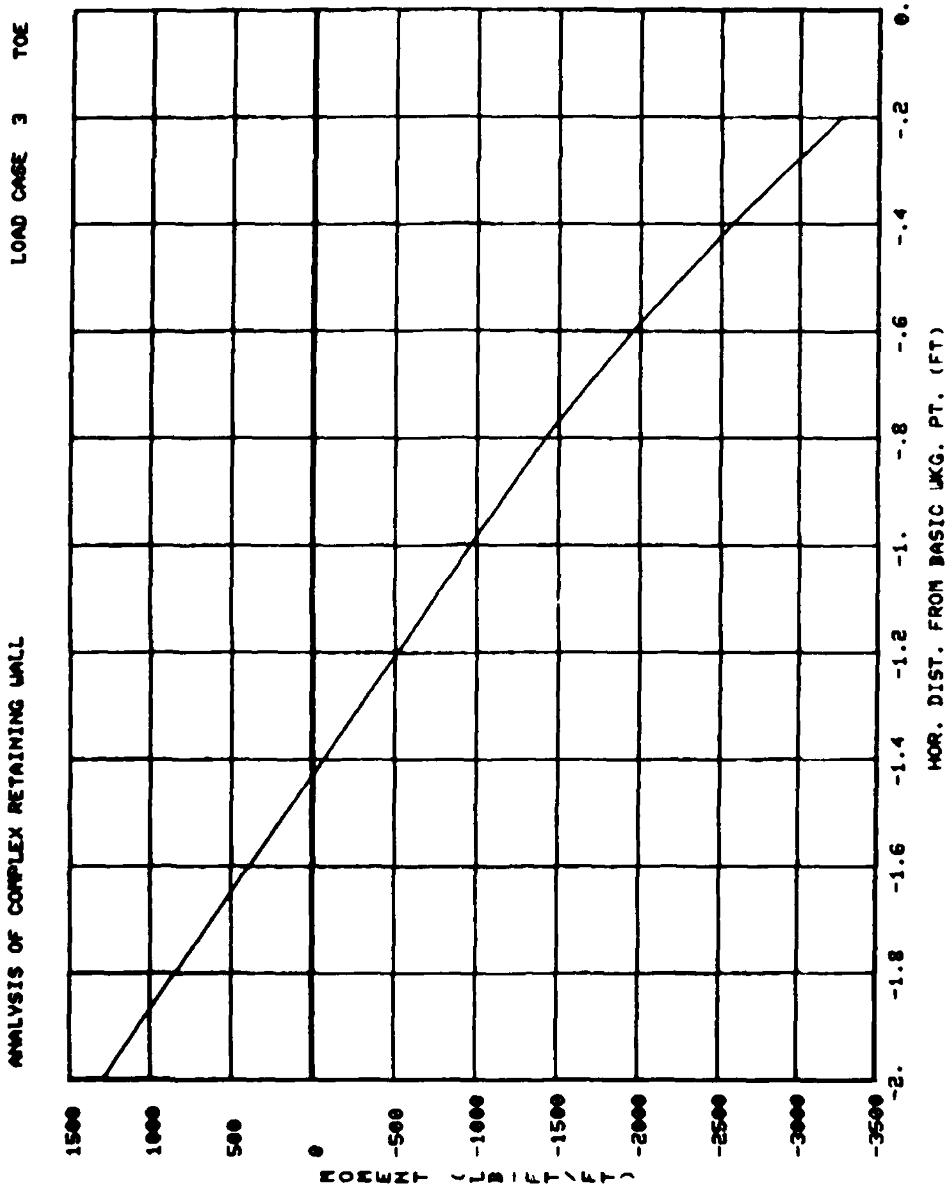
```
ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      * TO TERMINATE GRAPHICS
?2
ENTER 1 TO TURN PLOT TRACE OFF
      C TO CONTINUE WITH TRACE ON
        (WILL GENERATE LARGE AMOUNTS OF OUTPUT)
      * TO TERMINATE OUTPUT GRAPHICS
?1
ACTIVE LOAD CASES
****** **** *****
                3
                4
ENTER DESIRED ACTIVE LOADCASE
?3
TYPE IN MEMBER NUMBER (1-4)
      STEM --- 1
      TOE  --- 2
      KEY  --- 3
      HEEL --- 4
?1
```


ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 3 STEM
SHEAR FORCE (LB/FT)
ELEVATION (FT)
88.5
86.5
84.5
82.5
80.5
78.5
76.5
74.5
7.783
507.8
1000.
1500.
2000.
2500.
3000.
3500.
4000.

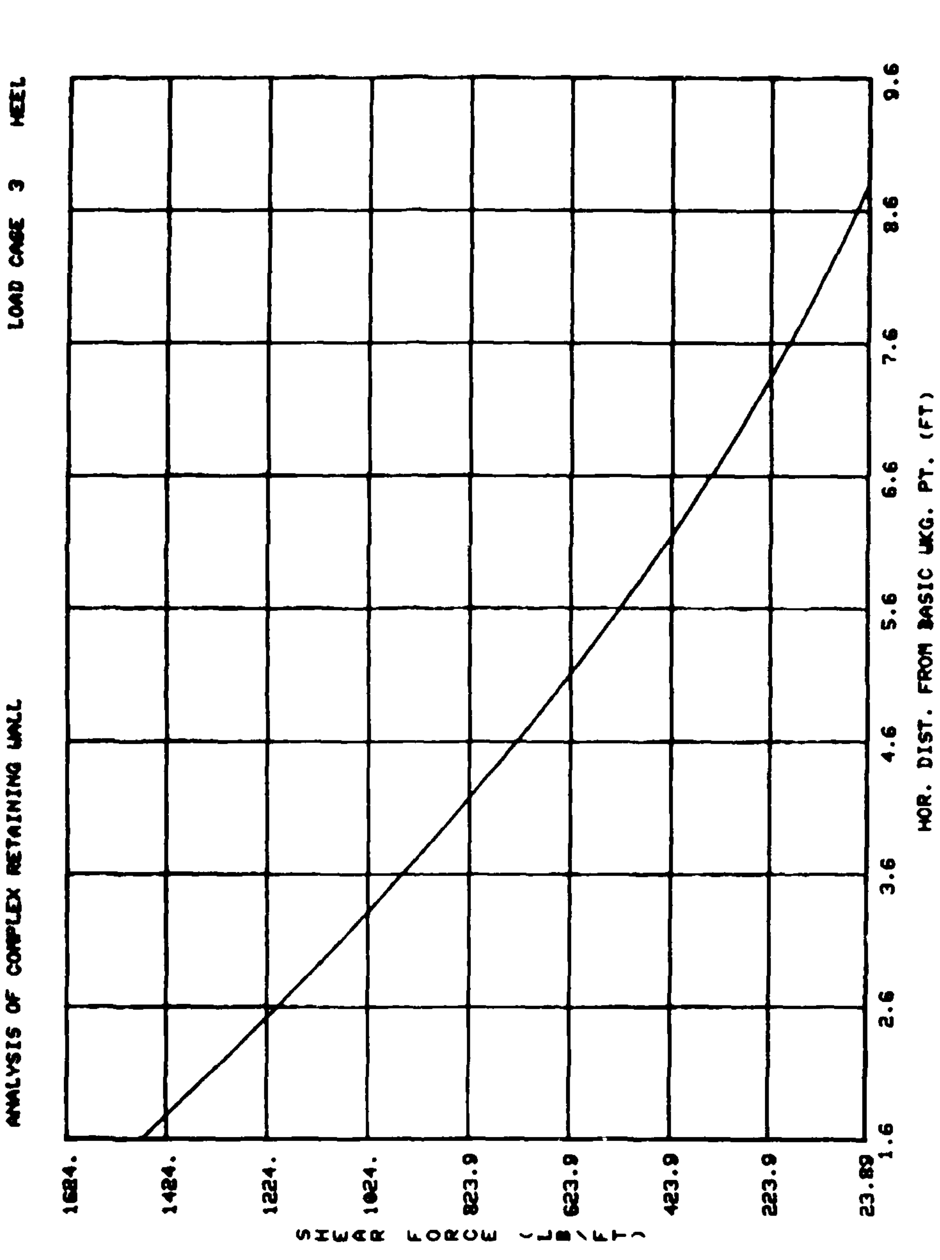

ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 3 STEM
88.5
86.5
84.5
82.5
80.5
78.5
76.5
74.5
ELEVATION (FT)
0.
2001.
4001.
6001.
8001.
.1000E+5
.1200E+5
.1400E+5
.1600E+5
.1800E+5
.2000E+5
MOMENT (LB-FT/FT)

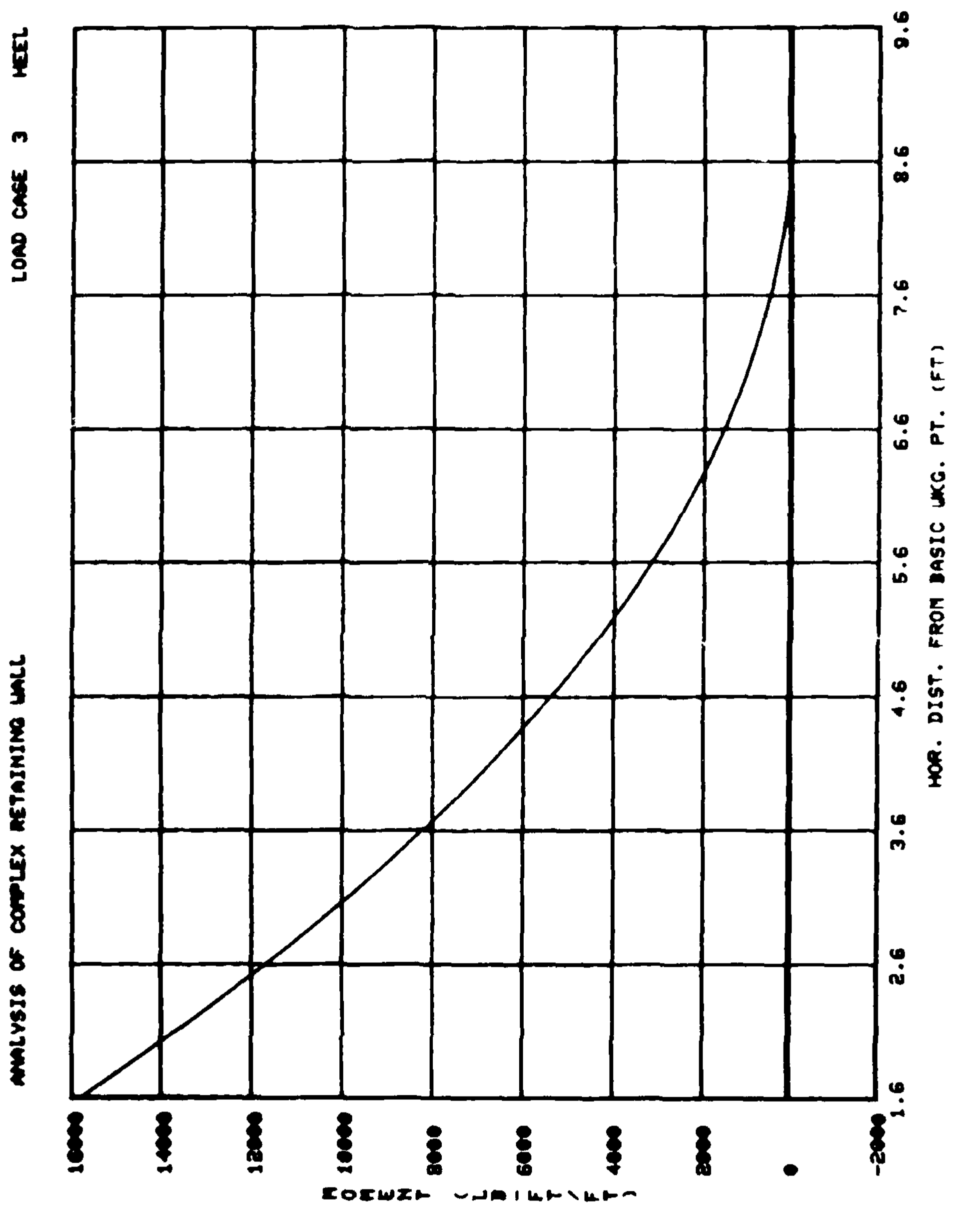
```
ENTER 1 TO PLOT ANOTHER MEMBER
      0 TO CONTINUE
?1
TYPE IN MEMBER NUMBER (1-4)
     STEM --- 1
     TOE  --- 2
     KEY  --- 3
     HEEL --- 4
?2
```

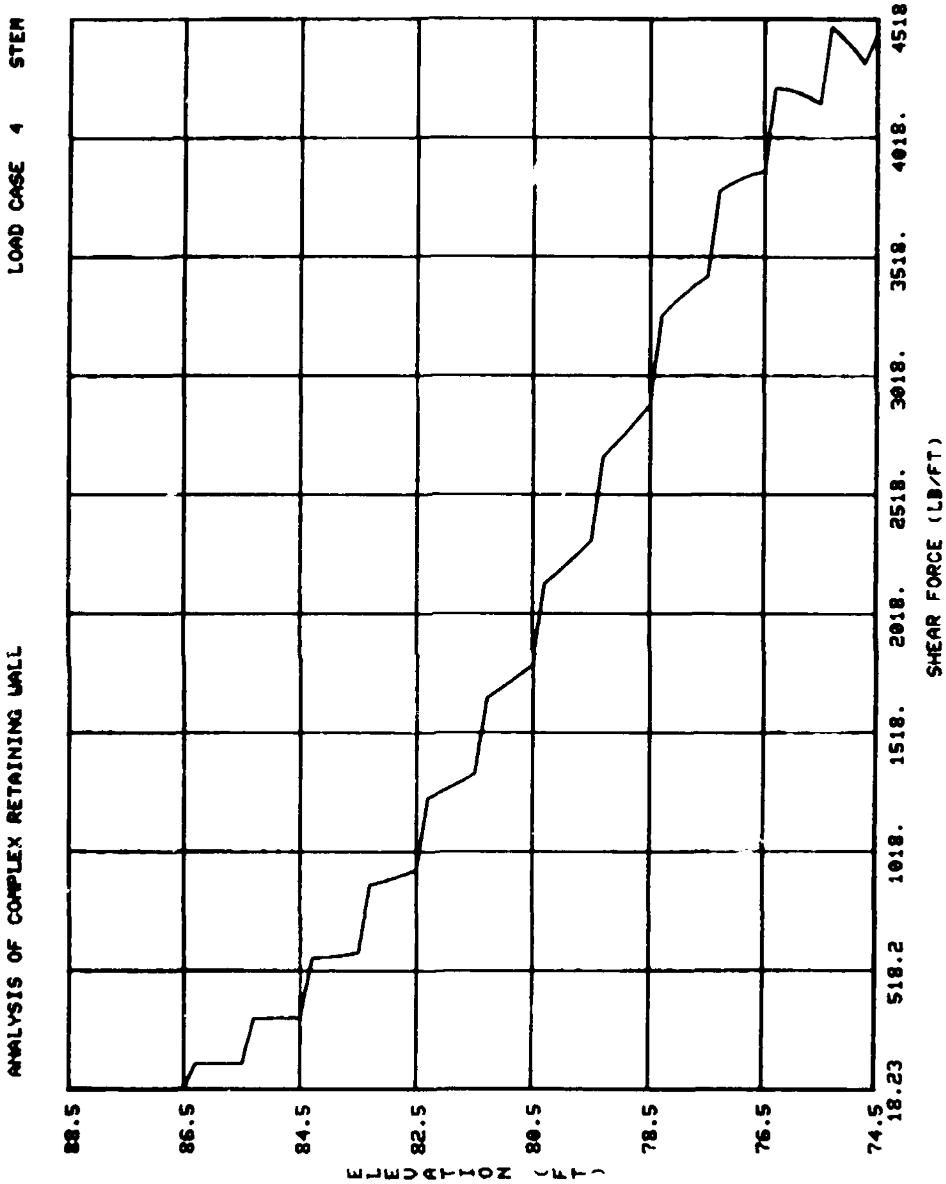

ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 3 TOE
301.4
-198.6
-698.6
-1199.
-2699.
-3199.
-3699.
SHEAR FORCE (LB/FT)
-2.
-1.8
-1.6
-1.4
-1.2
-1.
-.8
-.6
-.4
-.2
0.
HOR. DIST. FROM BASIC WKG. PT. (FT)


ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 3 TOE
HOR. DIST. FROM BASIC WKG. PT. (FT)
-2.
-1.8
-1.6
-1.4
-1.2
-1.
-.8
-.6
-.4
-.2
0.
1500
1000
500
0
-500
-1000
-1500
-2000
-2500
-3000
-3500

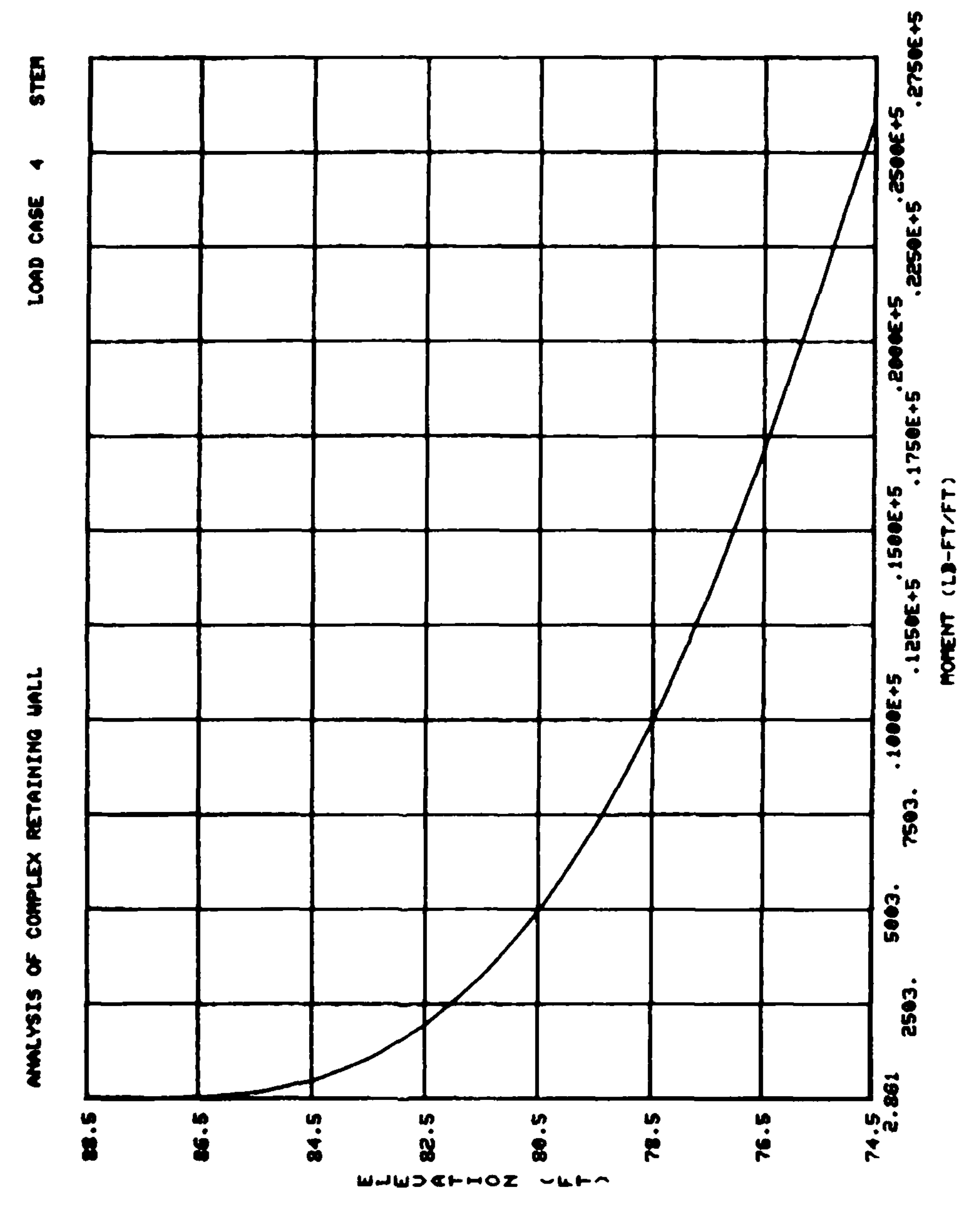
```
ENTER 1 TO PLOT ANOTHER MEMBER
      0 TO CONTINUE
?1
TYPE IN MEMBER NUMBER (1-4)
      STEM --- 1
      TOE  --- 2
      KEY  --- 3
      HEEL --- 4
?4
```


ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 3 HEEL
1624.
1424.
1224.
1024.
823.9
623.9
423.9
223.9
23.89
1.6
2.6
3.6
4.6
5.6
6.6
7.6
8.6
9.6
HOR. DIST. FROM BASIC WKG. PT. (FT)

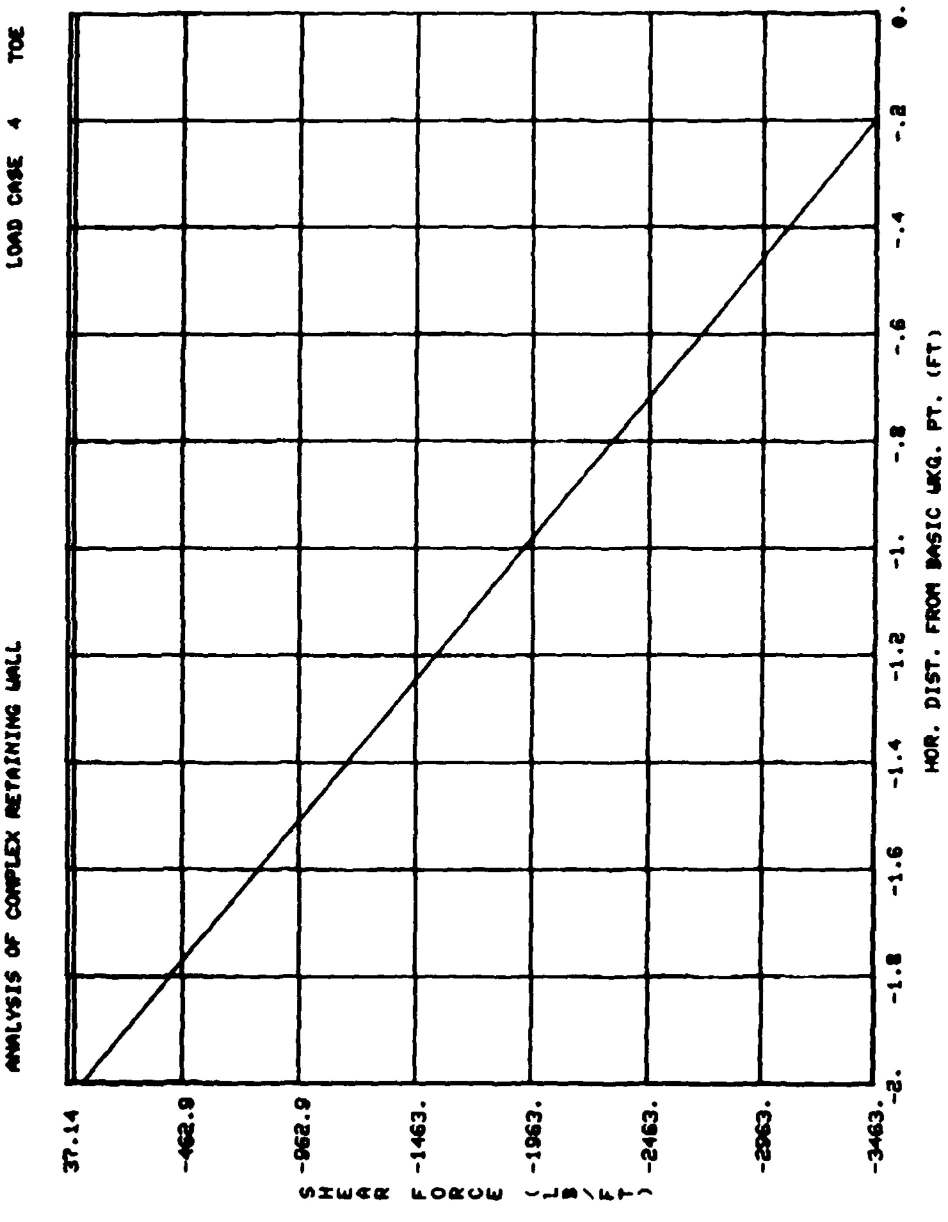

ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 3 HEEL
HOR. DIST. FROM BASIC WKG. PT. (FT)
1.6
2.6
3.6
4.6
5.6
6.6
7.6
8.6
9.6
16000
14000
12000
10000
8000
6000
4000
2000
0
-2000



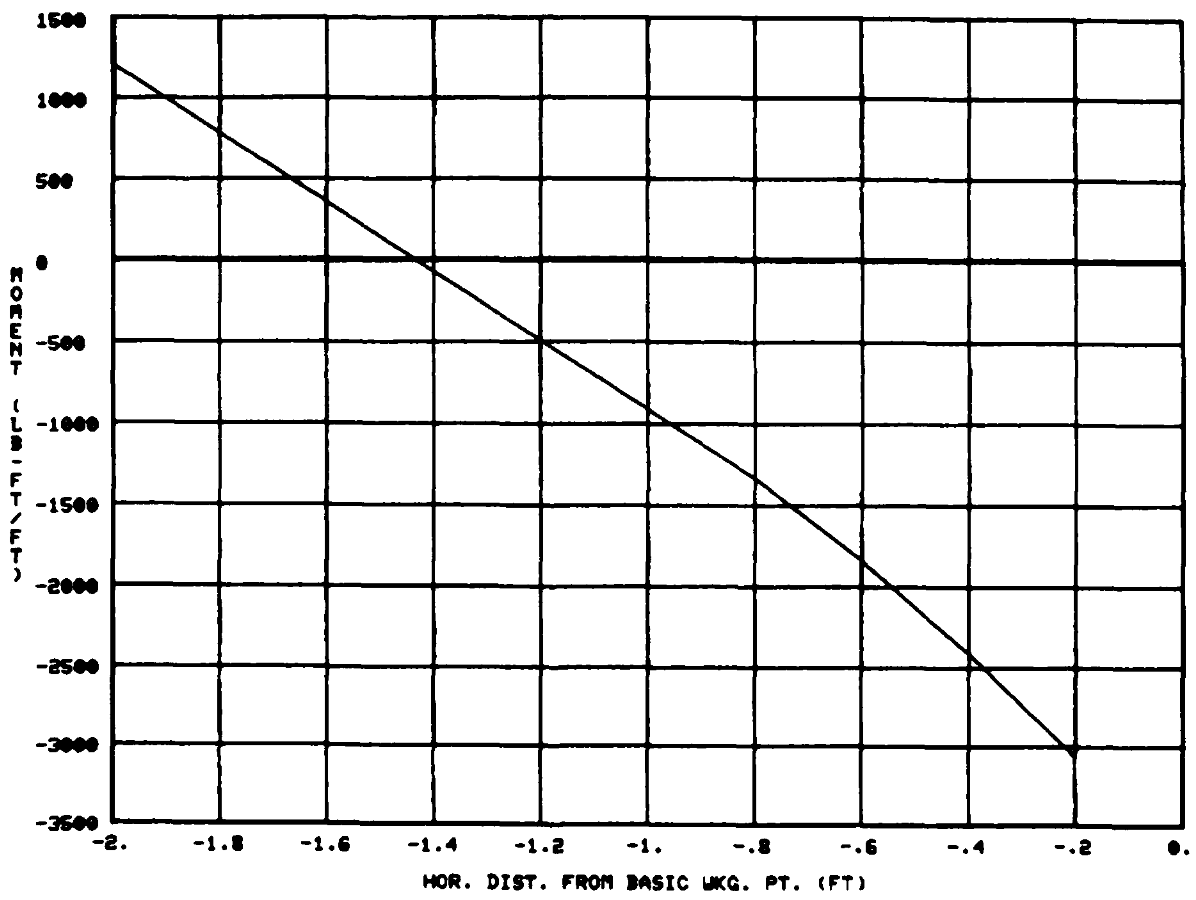
ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 4 STEM
88.5
86.5
84.5
82.5
80.5
78.5
76.5
74.5
ELEVATION (FT)
18.23
518.2
1018.
1518.
2018.
2518.
3018.
3518.
4018.
4518.
SHEAR FORCE (LB/FT)


ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 4 STEM
88.5
86.5
84.5
82.5
80.5
78.5
76.5
74.5
ELEVATION (FT)
2.881
2503.
5003.
7503.
.1000E+5
.1250E+5
.1500E+5
.1750E+5
.2000E+5
.2250E+5
.2500E+5
.2750E+5
MOMENT (LB-FT/FT)

```
ENTER 1 TO PLOT ANOTHER MEMBER
      0 TO CONTINUE
?1
TYPE IN MEMBER NUMBER (1-4)
     STEM --- 1
     TOE  --- 2
     KEY  --- 3
     HEEL --- 4
?2
```

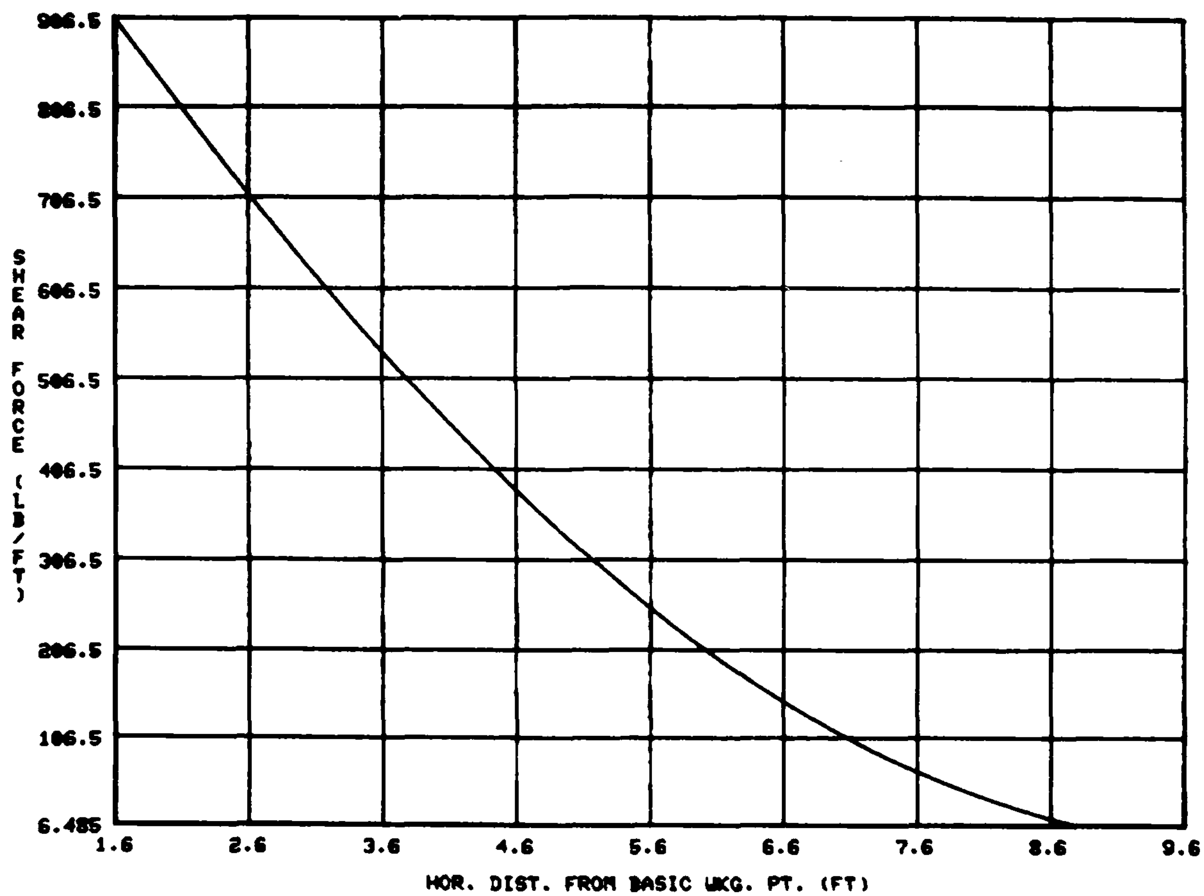

ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 4
TOE
37.14
-462.9
-962.9
-1463.
-1963.
-2463.
-2963.
-3463.
SHEAR FORCE (LB/FT)
-2.
-1.8
-1.6
-1.4
-1.2
-1.
-.8
-.6
-.4
-.2
0.
HOR. DIST. FROM BASIC WKG. PT. (FT)

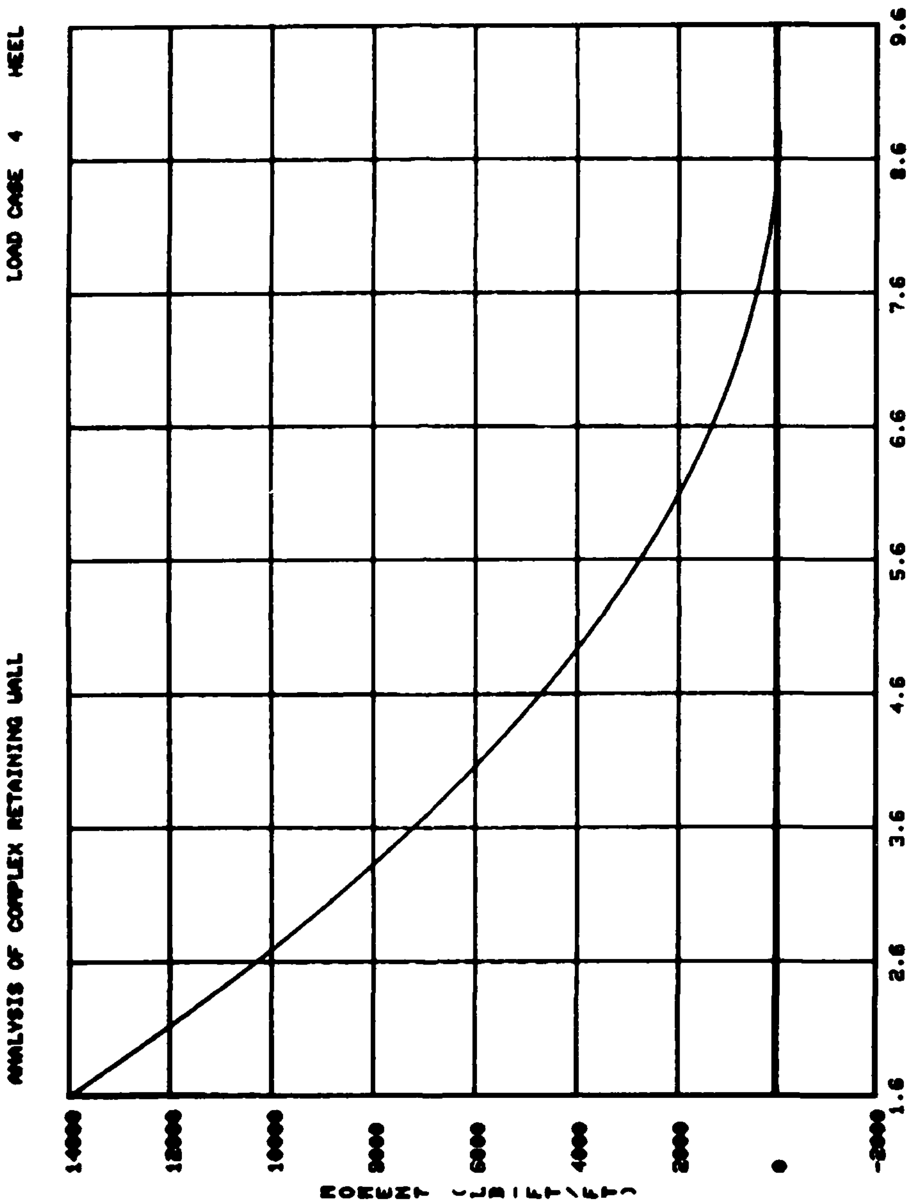
ANALYSIS OF COMPLEX RETAINING WALL LOAD CASE 4 TOE



```
ENTER 1 TO PLOT ANOTHER MEMBER
      0 TO CONTINUE
?1
TYPE IN MEMBER NUMBER (1-4)
      STEM --- 1
      TOE  --- 2
      KEY  --- 3
      HEEL --- 4
?4
```

ANALYSIS OF COMPLEX RETAINING WALL LOAD CASE 4 HEEL




ANALYSIS OF COMPLEX RETAINING WALL
LOAD CASE 4 HEEL
HOR. DIST. FROM BASIC WKG. PT. (FT)
1.6
2.6
3.6
4.6
5.6
6.6
7.6
8.6
9.6
0

```
ENTER 1 TO PLOT ANOTHER MEMBER
      0 TO CONTINUE
?0
ENTER 1 TO PLOT ANOTHER LOAD CASE
      0 TO CONTINUE
?0
ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      * TO TERMINATE GRAPHICS
?*
$$$

$
$ UPDATE FILE RESET
$


$
$ COMMAND-DATA PHASE ENTERED
$

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?5
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
?R0

SNUMB # 1933A

your update file for future restart is named EXV3UPD
stop     OK (release unneeded files)

*
```

4-4 REPORT FILE PRINTOUT. This printout was made with the full debugging trace on. Note the additional output resulting from the TRCE 1 command:

```
&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&
          11:14:32 ON 10/ 1/80



NOTES TO EXPLAIN SPECIAL PRINTOUT THAT MIGHT BE IN THIS FILE**

THE VALUE "-.1234E+31" IS USED TO DENOTE AN  UNDEFINED ITEM;
THE VALUE "-.1432E+31" MEANS THAT THE DEFAULT VALUE WAS REQUESTED.

A "MEMORY FAULT AT ..." MESSAGE PROBABLY MEANS THAT NEEDED DATA IS UNDEFINED.

.

END OF NOTES.

COMMAND ENTERED:
INIT

*- ALL DATA RESET FOR FRESH START -*

COMMAND ENTERED:
R

COMMAND ENTERED:
H
```

```
11:15:27 ON 10/ 1/80

WALL DECLARED TO BE A HYDRAULIC RETAINING WALL

COMMAND ENTERED:
NAME  ANALYSIS OF COMPLEX RETAINING WALL

COMMAND ENTERED:
CASE 2 3 4

COMMAND ENTERED:
SPT7  0  30.0  0.0  120.0

COMMAND ENTERED:
SPH1  0  30.0  0.0  120.0

NOT ENOUGH VALUES ENTERED IN DATA LIST - SPH1
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
SST   0  77.0  100.0

COMMAND ENTERED:
SSHC  0  87.29  6.0

COMMAND ENTERED:
SPE3  18.0  0.0  120.0  18.0  0.0

NOT ENOUGH VALUES ENTERED IN DATA LIST - SPE3
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
SCEV  4  400.0  2.0  800.0  4.0   400.0  7.0

NOT ENOUGH VALUES ENTERED IN DATA LIST - SCEV
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
SCWV  4  600.0  3.0  0.5

NOT ENOUGH VALUES ENTERED IN DATA LIST - SCWV
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
SEEP  3  77.0  84.5

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
SEEP  4  77.0  84.5

NOT ENOUGH VALUES ENTERED IN DATA LIST - SEEP
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
WLA  87.5  2.0  C  C

COMMAND ENTERED:
WLAB  11.0  10.0  12.0  0.0

COMMAND ENTERED:
WLAS  12.0  0.0  18.0  0.0  0.0  C

COMMAND ENTERED:
WLAT  72.5  18.0  100.0  0.0  100.0
```

```
COMMAND ENTERED:
WLAH  18.0  C  24.0

COMMAND ENTERED:
STLS  1  0.89  1  0.89

COMMAND ENTERED:
STLH  1  1  0.89  1  0.89

COMMAND ENTERED:
STLH  12  1  0.89  1  0.89

COMMAND ENTERED:
UPDATE

#
# UPDATE FILE RESET
#


COMMAND ENTERED:


COMMAND ENTERED:
TRCE 1

COMMAND ENTERED:
RUN FA




ANALYSIS OF COMPLEX RETAINING WALL
         11:18: 4 ON 10/ 1/80


#
# BEGIN BASIC STABILITY DATA CHECK
#

DEFAULT VALUE OF    62.50000     USED FOR GAMAW      (LOAD CASE  3)

DEFAULT VALUE OF    150.0000     USED FOR GAMAC      (LOAD CASE  3)

DEFAULT VALUE OF    1.000000     USED FOR ESS        (LOAD CASE  3)

DEFAULT VALUE OF    2.000000     USED FOR EXW        (LOAD CASE  3)

DEFAULT VALUE OF   0.            USED FOR UCEXS3     (LOAD CASE  3)

DEFAULT VALUE OF   0.            USED FOR UCEXS4     (LOAD CASE  3)

DEFAULT VALUE OF   0.            USED FOR UCEXS5     (LOAD CASE  3)

DEFAULT VALUE OF   0.            USED FOR UCBFS1     (LOAD CASE  3)

DEFAULT VALUE OF   0.            USED FOR UCBFS2     (LOAD CASE  3)

DEFAULT VALUE OF   0.            USED FOR UCBFFZ     (LOAD CASE  3)

DEFAULT VALUE OF   0.            USED FOR UCBFS7     (LOAD CASE  3)

DEFAULT VALUE OF   0.            USED FOR UCBFS6     (LOAD CASE  3)
```

```
DEFAULT VALUE OF    1.000000     USED FOR UCWS      (LOAD CASE  3)
DEFAULT VALUE OF    1.000000     USED FOR UCWB      (LOAD CASE  3)
DEFAULT VALUE OF    1.000000     USED FOR UCWK      (LOAD CASE  3)
DEFAULT VALUE OF           2     USED FOR IFWOC     (LOAD CASE  3)
DEFAULT VALUE OF           1     USED FOR IFSOM     (LOAD CASE  3)
DEFAULT VALUE OF    1.000000     USED FOR CFMA      (LOAD CASE  3)
DEFAULT VALUE OF   0.3333333     USED FOR RRMIN     (LOAD CASE  3)
DEFAULT VALUE OF           2     USED FOR KRACK     (LOAD CASE  3)
DEFAULT VALUE OF    2.000000     USED FOR FSMIN     (LOAD CASE  3)
DEFAULT VALUE OF           1     USED FOR NSLIDE    (LOAD CASE  3)
DEFAULT VALUE OF   0.            USED FOR HGSW      (LOAD CASE  3)
> DS1H(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)
> HS1(LC)     FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)
> WDS2(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)
> HS2(LC)     FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)
> VALUE OF HS3(LC)     FOUND =    6.000000     IN S/R CHEKRT (LOAD CASE  3)
DEFAULT VALUE OF           2     USED FOR IFWOC     (LOAD CASE  4)
DEFAULT VALUE OF           1     USED FOR IFSOM     (LOAD CASE  4)
DEFAULT VALUE OF    1.000000     USED FOR CFMA      (LOAD CASE  4)
DEFAULT VALUE OF   0.3333333     USED FOR RRMIN     (LOAD CASE  4)
DEFAULT VALUE OF           2     USED FOR KRACK     (LOAD CASE  4)
DEFAULT VALUE OF    2.000000     USED FOR FSMIN     (LOAD CASE  4)
DEFAULT VALUE OF           1     USED FOR NSLIDE    (LOAD CASE  4)
DEFAULT VALUE OF   0.            USED FOR HGSW      (LOAD CASE  4)
> DS1H(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)
> HS1(LC)     FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)
> WDS2(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)
> HS2(LC)     FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)
> VALUE OF HS3(LC)     FOUND =    6.000000     IN S/R CHEKRT (LOAD CASE  4)
> VALUE OF FSS         FOUND =    1.000000     IN S/R CHEKRT (LOAD CASE  5)
> VALUE OF FXW         FOUND =    2.000000     IN S/R CHEKRT (LOAD CASE  5)
DEFAULT VALUE OF    100.0000     USED FOR HS55H     (LOAD CASE  5)
DEFAULT VALUE OF   0.            USED FOR DTS5H     (LOAD CASE  5)
```

```
ANALYSIS OF COMPLEX RETAINING WALL
        11:18: 4 ON 10/ 1/80


*
* BEGIN PART 2 OF STABILITY DATA CHECK
*


ANALYSIS OF COMPLEX RETAINING WALL
        11:18: 4 ON 10/ 1/80


*
* BEGIN MODULE FA
*

LOAD
PRXYWL
VARIABLE TMINS  ASSIGNED DEFAULT VALUE OF       12.00
VARIABLE TMINB  ASSIGNED DEFAULT VALUE OF       12.00
VARIABLE DKEY   ASSIGNED DEFAULT VALUE OF        0.
VARIABLE HEELW CALCULATED        7.50 (BW-TW2-TSTB)
VARIABLE HSBPB  ASSIGNED DEFAULT VALUE OF   -0.14E 31
VARIABLE IBSAME UNDEFINED.
VARIABLE IBSAME ASSIGNED DEFAULT VALUE OF        0.
XYWALL
VARIABLE HSBPB CALCULATED OR DEFAULTED TO CLOSE COORDINATES,
        HSBPB =  0.461538 IN/FT.
XYWALL
```

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	87.5000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	0.	74.0000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	0.	74.0000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-2.0000	74.0000	TOP OF TOEHT = AT OUTER END OF TW2
5	-2.0000	72.5000	TOE END OF BASE = AT BTE1
6	9.0000	72.5000	TOP OF TOE-SIDE FACE OF KEY
7	9.0000	72.5000	BOTTOM OF TOE-SIDE FACE OF KEY
8	9.0000	72.5000	BOTTOM OF HEEL-SIDE FACE OF KEY
9	9.0000	72.5000	TOP OF HEEL-SIDE FACE OF KEY
10	9.0000	72.5000	HEEL END OF BASE
11	9.0000	74.0000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	1.5000	74.5000	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.0000	87.5000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.0000	87.5000	TOP OF HEEL-SIDE FACE OF STEM

```
> FUNCT. YSH =   87.45667     FROM X =    1.000000
> FUNCT. YSH =   87.54000     FROM X =    1.500000
> FUNCT. YSH =   87.45667     FROM X =    1.000000
> FUNCT. YSH =   87.54000     FROM X =    1.500000
WALL STEM.
SUMWT
VOL =          0.  ,VOLMOM =        0.  ,SWT =         0.  ,SM =         0.
SUM
SUMVF =          0.  ,SUMHF =         0.  ,SUMMOM =         0.
```

AD-A099 377 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS F/G 13/13
VALIDATION REPORT: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF --ETC(U)
FEB 81 W A PRICE, R L HALL, R L MOSHER
UNCLASSIFIED WES-INSTRUCTION-K-81-3 NL

3 OF 4
AD A099377

```
SUMWT
VOL =        13.3 ,VOLMOM =        33.3 ,SWT =      2000.0,SM =       4995.8
SUM
SUMVF =      2000.0 ,SUMHF =          0.  ,SUMMOM =       4995.8
SUMWT
VOL =          0.  ,VOLMOM =          0.  ,SWT =          0. ,SM =          0.
SUM
SUMVF =      2000.0 ,SUMHF =          0.  ,SUMMOM =       4995.8
SUMWT
VOL =         3.3 ,VOLMOM =        10.4 ,SWT =       493.8,SM =       1563.5
SUM
SUMVF =      2493.8 ,SUMHF =          0.  ,SUMMOM =       6559.4

WALL STEM AND BASE =
SUMWT
VOL =         3.0 ,VOLMOM =         3.0 ,SWT =       450.0,SM =        450.0
SUM
SUMVF =      2943.8 ,SUMHF =          0.  ,SUMMOM =       7009.4
SUMWT
VOL =          0.  ,VOLMOM =          0.  ,SWT =          0. ,SM =          0.
SUM
SUMVF =      2943.8 ,SUMHF =          0.  ,SUMMOM =       7009.4
SUMWT
VOL =         2.6 ,VOLMOM =         7.3 ,SWT =       393.8,SM =       1096.9
SUM
SUMVF =      3337.5 ,SUMHF =          0.  ,SUMMOM =       8106.3
SUMWT
VOL =        13.1 ,VOLMOM =        92.8 ,SWT =      1968.8,SM =      13921.9
SUM
SUMVF =      5306.3 ,SUMHF =          0.  ,SUMMOM =      22028.1

WALL STEM,BASE,AND KEY =
SUMWT
VOL =          0.  ,VOLMOM =          0.  ,SWT =          0. ,SM =          0.
SUM
SUMVF =      5306.3 ,SUMHF =          0.  ,SUMMOM =      22028.1
SUMWT
VOL =          0.  ,VOLMOM =          0.  ,SWT =          0. ,SM =          0.
SUM
SUMVF =      5306.3 ,SUMHF =          0.  ,SUMMOM =      22028.1

STEMV,BASEV,VOLKEY
       16.6        8.8          0.
SUMVF =     5306.3 ,SUMHF =          0. ,SUMMOM =   22028.1

> OUTPROF, ESTW=        77.00SST=       100.00ESHW=          87.29
HS1=    -0.12E 31HS2=    -0.12E 31HS3=           6.00DS1H=    -0.12E 31
WDS2=    -0.12E 31DTSST=          0.  ELTSST=          77.00
ESS=          1.00DTSSH=          0.  ELTSSH=          87.29
HSSSH=          6.00ELTSSW=       87.29EXW=            2.00
> SUBROUTINE BPROFILE, PROF(I) AS I = 1 TO ISEL
          899009.          0.                87.5000          0.
          74.0000          0.                74.0000         -2.00000
          74.0000         -2.00000           72.5000          9.00000
          72.5000          9.00000           72.5000          9.00000
          72.5000          9.00000           72.5000          9.00000
          72.5000          9.00000           74.0000          1.50000
          74.5000          1.00000           87.5000          1.00000
          87.5000          899010.          -60.0000         77.0000
        0.100000E-01      77.0000          0.100000E-01      87.2900
          60.0000         97.2900            899007.        -60.0000
          77.0000        0.100000E-01        77.0000          899001.
        0.100000E-01      87.2900            60.0000         97.2900
```

```
   IT         IT2        IT1        ISN
      44         47         45          1
   IT         IT2        IT1        ISN
      59         42         40          7
   IT         IT2        IT1        ISN
      30         37         31         10
   S/R HPROFILE ENDS WITH PROF(I) AS I = 1 TO ISE:
        899009.       -60.0000         77.0000        0.
        77.0000       0.               87.5000        1.00000
        87.5000        1.00000         87.5000        1.00172
        87.4553        60.0000         97.2900        899007.
       -60.0000        77.0000        0.              77.0000
        899001.        1.00172         87.4553        60.0000
        97.2900        899010.        -2.00000        72.5000
       -2.00000        74.0000        0.              74.0000
       0.              74.0000        0.              77.0000
        899010.        1.00172         87.4553        1.50000
        74.5000        9.00000         74.0000        9.00000
        72.5000        9.00000         72.5000        9.00000
        72.5000
> FUNCT, YSH =   88.79000      FROM X =   9.000000
  IN FC 9 -- LC, ISE =          3          60
  PROF(I),I=1,ISE =
        899009.       -60.0000         77.0000       -8.50000
        77.0000       0.               77.0000        0.
        87.5000        1.00000         87.5000        1.00172
        87.4553        30.9480         92.4480        60.0000
        97.2900        899007.        -8.50000        77.0000
       0.              77.0000         899001.        1.00172
        87.4553        30.9470         92.4470        899010.
        1.00172        87.4553         1.50000        74.5000
        9.00000        74.0000         9.00000        72.5000
        899010.       -2.00000         72.5000       -2.00000
        74.0000       0.               74.0000        0.
        77.0000        899023.        -60.0000        77.0000
       -8.50000        77.0000        -4.00000        72.5000
        9.00000        72.5000         11.0000        72.5000
        30.9480        92.4480         60.0000        97.2900
   --- END OF S/R OUTPROF ---
>  IN WGHT
   --- END OF S/R WGHT ---
>  IN WGHT
   --- END OF S/R WGHT ---
>  IN WGHT
   --- END OF S/R WGHT ---
>  IN WGHT
   --- END OF S/R WGHT ---
>  IN WGHT
   --- END OF S/R WGHT ---
>  IN WGHT
   --- END OF S/R WGHT ---
>  IN WGHT
   --- END OF S/R WGHT ---

> SUMS IN WTSOIL FOR LAYERS 1, 2, FZ:
SUM
SUMVF =     18218.2 ,SUMHF =          0.  ,SUMMOM =   115897.6

> SUMS IN WTSOIL FOR LAYERS 6, 7:
SUM
SUMVF =     18938.2 ,SUMHF =          0.  ,SUMMOM =   115817.6
> IN WGHT
   --- END OF S/R WGHT ---
   -- END OF S/R WTSOIL --
```

```
ANALYSIS OF COMPLEX RETAINING WALL
        11:18: 7 ON 10/ 1/80


#
# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#

> DS1H(LC)   FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> HS1(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> WDS2(LC)   FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> HS2(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> VALUE OF HS3(LC)    FOUND =    6.000000     IN S/R CHEKRT (LOAD CASE  3)

NSURL AT BEGINNING OF S/R SURFACE= 1
B1= 87.29  S1=  0.17  B2=113.50  S2=-26.00

> VALUE OF FSS        FOUND =    1.000000     IN S/R CHEKRT (LOAD CASE  3)

> VALUE OF FXW        FOUND =    2.000000     IN S/R CHEKRT (LOAD CASE  3)

> VALUE OF HSS5H      FOUND =    6.000000     IN S/R CHEKRT (LOAD CASE  3)

> VALUE OF DTS5H      FOUND =   0.            IN S/R CHEKRT (LOAD CASE  3)
B2= 61.50  S2=  1.00  B1N= 87.29  S1N=  0.17
BF= 70.09  SF=  0.27  B1N= 87.29  S1N=  0.17
      1   9.00  88.79
      2  50.95  92.45
      3 169.85 115.60
NSURL AT END OF S/R SURFACE = 2
SURFACE 1  GAMA=120.00  COH=  0.     PHI= 30.00
SURFACE 2  GAMA=120.00  COH=  0.     PHI= 18.00

> GAMAS2(LC) FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> VALUE OF GAMAS1(LC) FOUND =    120.0000     IN S/R CHEKRT (LOAD CASE  3)

> VALUE OF COH1(LC)   FOUND =   0.            IN S/R CHEKRT (LOAD CASE  3)

> VALUE OF PHI1(LC)   FOUND =    30.00000     IN S/R CHEKRT (LOAD CASE  3)

DEFAULT VALUE OF    0.            USED FOR DELTA1(LC) (LOAD CASE  3)

> GAMASF(LC) FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKAFZ(LC)  FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKA2(LC)   FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKA1(LC)   FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKAFFZ(LC) FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKAF2(LC)  FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKAF1(LC)  FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKH(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> VALUE OF ELWH(LC)   FOUND =    84.50000     IN S/R CHEKRT (LOAD CASE  3)
```

```
THE VERTICAL INCREMENT =  1.00 FT.  NO.OF WALL POINTS =  2

WALL PT.   X        Y
    1       9.00  88.79
    2       9.00  72.50

NUMBER OF SOIL LAYERS =1
SOIL NO.  GAMMA     COH     PHI    DELTA
   1       120.00   0.      30.00   0.
SOIL NO 1  KA ********  KAF =  0.
WATER EL. = 84.50  ACCEL =  0.     BETA =  9.46
ELEV AT BOTTOM OF SOIL 1   = 72.50
LINE LOAD 1  MAG =  0.     DIST =  0.
MAG OF UNIF LOAD =  0.     DIST TO LEFT END =  0.    DIST TO RIGHT END =  0.

      ENTERING S/R CLASSIC FROM MODULE SA-SP

   INPUT DATA FOR SUBROUTINE CLASSIC

   BACKFILL DESCRIPTION

   EQUIV. SURFACE SLOPE          =       9.46
   ELEVATION OF WATER SURFACE    =      84.50
   INCREMENT LENGTH              =       1.00

   BACKFILL SOIL DESCRIPTION

      FROM      TO        UNIT WT          PHI           C           KA
      (FT)     (FT)        (PCF)          (DEG)        (PSF)
    SURFACE   72.50       120.00          30.00          0.       ********

   WALL BREAK POINTS

   POINT        X-COORD    Y-COORD
     NO          (FT)       (FT)
      1          9.00       88.79
      2          9.00       72.50


   DATA FROM SUBROUTINE CLASSIC


  COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
     BACKFILL LAYER              KA VALUE
     --------------              --------
            1                     0.3711
            2                     0.3711


   COORDINATES AND STATIC ACTIVE SOIL PRESSURES
   FOR EACH SOIL LAYER

      COORDINATES          ACTIVE           ACTIVE
      AT WALL  (FT)        PRESSURE         COEFF.
        X       Y           (PSF)
      9.00    88.79          0.            0.3711
      9.00    84.50        191.02          0.3711
      9.00    84.50        191.02          0.3711
      9.00    72.50        487.05          0.3711
```

STATIC ACTIVE SOIL FORCES

Y-COORD (FT)	SOIL FORCE (LB/FT) HORIZONTAL	VERTICAL
88.79	7.42	0.
87.79	44.53	0.
86.79	89.05	0.
85.79	133.58	0.
84.79	176.73	0.
83.79	206.08	0.
82.79	227.51	0.
81.79	248.84	0.
80.79	270.18	0.
79.79	291.51	0.
78.79	312.85	0.
77.79	334.19	0.
76.79	355.52	0.
75.79	376.86	0.
74.79	398.19	0.
73.79	419.53	0.
72.79	281.10	0.
72.50	64.52	0.

OUTPUT FROM SUBROUTINE CLASSIC

POINT NO	Y-COORD (FT)	STATIC FORCES (LB/FT) HORIZ	VERT	EARTHQUAKE FORCES (LB/FT) HORIZ	VERT
1	88.79	7.42	0.	0.	0.
2	87.79	44.53	0.	0.	0.
3	86.79	89.05	0.	0.	0.
4	85.79	133.58	0.	0.	0.
5	84.79	176.73	0.	0.	0.
6	83.79	206.08	0.	0.	0.
7	82.79	227.51	0.	0.	0.
8	81.79	248.84	0.	0.	0.
9	80.79	270.18	0.	0.	0.
10	79.79	291.51	0.	0.	0.
11	78.79	312.85	0.	0.	0.
12	77.79	334.19	0.	0.	0.
13	76.79	355.52	0.	0.	0.
14	75.79	376.86	0.	0.	0.
15	74.79	398.19	0.	0.	0.
16	73.79	419.53	0.	0.	0.
17	72.79	281.10	0.	0.	0.
18	72.50	64.52	0.	0.	0.

RESULTANTS OF STATIC SOIL AND SURCHARGE FORCES

HORIZONTAL = 4238.20 (LB/FT) AT Y = 78.49 (FT)
VERTICAL = 0. (LB/FT)

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 3
FOR CLASSIC(COULOMB) ANALYSIS IN SA (END OF HEEL)

OUTPUT OF ARRAYS H, EH, AND YH IN MODULE SA FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
88.790	7.4212	0.
87.790	44.527	0.
86.790	89.055	0.
85.790	133.58	0.
84.790	176.73	0.
83.790	206.08	0.
82.790	227.51	0.
81.790	248.84	0.
80.790	270.18	0.
79.790	291.51	0.
78.790	312.85	0.
77.790	334.19	0.
76.790	355.52	0.
75.790	376.86	0.
74.790	398.19	0.
73.790	419.53	0.
72.790	281.10	0.
72.500	64.524	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 4238.20 LBS/HORIZ FT
ACTING AT ELEVATION 78.49

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

```
SUM
SUMVF =    15938.2 ,SUMHF =     4238.2 ,SUMMOM =    90416.5
SCHAR
> FUNCT, YSH =   87.45801     FROM X =   1.008077
> FUNCT, YSH =   87.45747     FROM X =   1.004846
> FUNCT, YSH =   87.45721     FROM X =   1.003241
> FUNCT, YSH =   87.45707     FROM X =   1.002443
> FUNCT, YSH =   87.45701     FROM X =   1.002047
> FUNCT, YSH =   87.45701     FROM X =   1.002047
> FUNCT, YSH =   89.12367     FROM X =   11.00205
> FUNCT, YSH =   89.29034     FROM X =   12.00205
> FUNCT, YSH =   89.45701     FROM X =   13.00205
```

```
SURCHARGE LOADS


    PVT        XDVT         PVH        XDVH
-0,12E 31 -0,12E 31 -0,12E 31 -0,12E 31
-0,12E 31 -0,12E 31 -0,12E 31 -0,12E 31
-0,12E 31 -0,12E 31 -0,12E 31 -0,12E 31
-0,12E 31 -0,12E 31 -0,12E 31 -0,12E 31
-0,12E 31 -0,12E 31 -0,12E 31 -0,12E 31

     TW(1)     TW(2)     TOW(1)    TOW(2)    TWW(1)    TWW(2)
-0,123E 31-0,123E 31 0,123E 31-0,123E 31-0,123E 31-0,123E 31

PONSTR



LC =  3

> PWIND ENTERED, W(LC) =  -0,123400E 31
  WIND F, M =    0,                  0,              SUMMATION FOLLOWS--
SUM
SUMVF =      18938,2 ,SUMHF =      4238,2 ,SUMMOM =     90416,5

> ENTER EARTHQ FOR LOAD CASE  3--
  RKH, RKV =    0,                -0,123400E 31

> SUBROUTINE YCNB ENTERED FOR LOAD CASE  3
  SOIL LAYER 7 AREA, AY =     6,00000          453,000
    X-COORDINATE + Y-COORDINATE
      -2,00000          74,0000
      0,                74,0000
      0,                74,0000
      0,                77,0000
      -2,00000          77,0000
  CONCRETE OUTLINE AREA, AY =     35,3750         2712,58
  SOIL LAYER 1 AREA, AY =     107,599         8744,57
    X-COORDINATE + Y-COORDINATE
      9,00000           74,0000
      9,00000           88,7886
      1,00172           87,4553
      1,50000           74,5000
  SUMA(WEIGHT)  AT YC(ELEVATION) = MOMENT
   18938,2             79,7646        0,151060E 07
  HORIZONTAL INERTIAL  FORCE AT ELEV, YC =     79,7646     --
     SWT VERT FORCE, SH HORIZ FORCE, MOMENT
        0,              0,              0,
SUM
SUMVF =      18938,2 ,SUMHF =      4238,2 ,SUMMOM =     90416,5

> ENTERING S/R WESWAT WITH LC, YZERO, NSIDE =  3     72,50****
   COMPUTED FSUM, XMSUM =    0,               0,
  S/R WESWAT TRACE ABOVE IS FOR WESTERGAARD WATER
SUM
SUMVF =      18938,2 ,SUMHF =      4238,2 ,SUMMOM =     90416,5
  END OF S/R EARTHQ
```

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND
THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT
ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE HS-H4 WATER PRESSURE
IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 3

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	5306.25	0.	22028.13
ACTIVE EARTH	0.	4238.20	-25401.20
SOIL+WATER	13631.94	0.	93789.52
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	18938.19	4238.20	90416.45

```
 > OUTPROF, ESTW=       77.00SST=       100.00ESHW=        87.29
HS1=    -0.12E 31HS2=    -0.12E 31HS3=          6.00DS1H=    -0.12E 31
HDS2=    -0.12E 31DTSST=          0.  ELTSST=        77.00
ESS=         1.00DTSSH=         0.  ELTSSH=        87.29
HSSSH=          6.00ELTSSW=       87.29EXW=          2.00

 > SUBROUTINE BPROFILE, PROF(I) AS I = 1 TO ISE:
        899009.          0.              87.5000          0.
        74.0000          0.              74.0000         -2.00000
        74.0000         -2.00000         72.5000          9.00000
        72.5000          9.00000         72.5000          9.00000
        72.5000          9.00000         72.5000          9.00000
        72.5000          9.00000         74.0000          1.50000
        74.5000          1.00000         87.5000          1.00000
        87.5000          899010.        -60.0000         77.0000
      0.100000E-01       77.0000       0.100000E-01      87.2900
        60.0000          97.2900         899007.        -60.0000
        77.0000        0.100000E-01      77.0000          899001.
      0.100000E-01       87.2900         60.0000          97.2900
   IT         IT2         IT1         ISN
      44          47          45          1
   IT         IT2         IT1         ISN
      39          42          40          7
   IT         IT2         IT1         ISN
      30          37          31         10
   S/R HPROFILE ENDS WITH PROF(I) AS I = 1 TO ISE:
        899009.         -60.0000         77.0000          0.
        77.0000          0.              87.5000          1.00000
        87.5000          1.00000         87.5000          1.00172
        87.4553          60.0000         97.2900          899007.
       -60.0000          77.0000          0.              77.0000
        899001.          1.00172         87.4553          60.0000
        97.2900          899010.        -2.00000          72.5000
       -2.00000          74.0000          0.              74.0000
        0.               74.0000          0.              77.0000
        899010.          1.00172         87.4553          1.50000
        74.5000          9.00000         74.0000          9.00000
        72.5000          9.00000         72.5000          9.00000
        72.5000
 > FUNCT, YSH =    88.79000      FROM X =     9.000000
   IN FC 9 -- LC, ISF =           4           60
   PROF(I),I=1,ISE =
        899009.         -60.0000         77.0000         -8.50000
        77.0000          0.              77.0000          0.
        87.5000          1.00000         87.5000          1.00172
        87.4553          30.9480         92.4480          60.0000
        97.2900          899007.        -8.50000          77.0000
        0.               77.0000         899001.          1.00172
```

```
        87.4553          30.9470          92.4470          899010.
        1.00172          87.4553          1.50000          74.5000
        9.00000          74.0000          9.00000          72.5000
        899010.         -2.00000          72.5000         -2.00000
        74.0000         0.                74.0000         0.
        77.0000          899023.         -60.0000          77.0000
       -8.50000          77.0000         -4.00000          72.5000
        9.00000          72.5000          11.0000          72.5000
        30.9480          92.4480          60.0000          97.2900

  *** END OF S/R OUTPROF ***
> IN WGHT
  *** END OF S/R WGHT ***
> IN WGHT
  *** END OF S/R WGHT ***
> IN WGHT
  *** END OF S/R WGHT ***
> IN WGHT
  *** END OF S/R WGHT ***
> IN WGHT
  *** END OF S/R WGHT ***
> IN WGHT
  *** END OF S/R WGHT ***
> IN WGHT
  *** END OF S/R WGHT ***

> SUMS IN WTSOIL FOR LAYERS 1, 2, FZ:
SUM
SUMVF =     18218.2 ,SUMHF =         0.  ,SUMMOM =   115097.6

> SUMS IN WTSOIL FOR LAYERS 6, 7:
SUM
SUMVF =     18938.2 ,SUMHF =         0.  ,SUMMOM =   115817.6
> IN WGHT
  *** END OF S/R WGHT ***
  ** END OF S/R WTSOIL **
```

```
ANALYSIS OF COMPLEX RETAINING WALL
        11:18: 9 ON 10/ 1/80


#
# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#


 > DS1H(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

 > HS1(LC)     FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

 > WDS2(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

 > HS2(LC)     FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

 > VALUE OF HS3(LC)     FOUND =     6.000000     IN S/R CHEKRT (LOAD CASE  4)


 NSURL AT BEGINNING OF S/R SURFACE= 1
 B1= 87.29  S1=  0.17  B2=113.50  S2=-26.00

 > VALUE OF ESS        FOUND =     1.000000     IN S/R CHEKRT (LOAD CASE  4)

 > VALUE OF EXW        FOUND =     2.000000     IN S/R CHEKRT (LOAD CASE  4)

 > VALUE OF HSS5H      FOUND =     6.000000     IN S/R CHEKRT (LOAD CASE  4)

 > VALUE OF DTS5H      FOUND =   0.             IN S/R CHEKRT (LOAD CASE  4)
 B2= 61.50  S2=  1.00  B1N= 87.29  S1N=  0.17
 BF= 70.09  SF=  0.27  B1N= 87.29  S1N=  0.17
       1   9.00  88.79
       2  30.95  92.45
       3 169.85 115.60
 NSURL AT END OF S/R SURFACE = 2
 SURFACE 1  GAMA=120.00  COH=  0.     PHI= 30.00
 SURFACE 2  GAMA=120.00  COH=  0.     PHI= 18.00

> GAMAS2(LC) FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> VALUE OF GAMAS1(LC) FOUND =    120.0000     IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF COH1(LC)   FOUND =   0.            IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF PHI1(LC)   FOUND =    30.00000     IN S/R CHEKRT (LOAD CASE  4)

DEFAULT VALUE OF    0.            USED FOR DELTA1(LC) (LOAD CASE  4)

> GAMASF(LC) FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKAFZ(LC)  FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKA2(LC)   FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKA1(LC)   FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKAEFZ(LC) FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKAE2(LC)  FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKAE1(LC)  FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKH(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> VALUE OF ELWH(LC)   FOUND =    84.50000     IN S/R CHEKRT (LOAD CASE  4)
```

```
THE VERTICAL INCREMENT =  1.00 FT.  NO.OF WALL POINTS =  2

WALL PT.   X        Y
    1      9.00   88.79
    2      9.00   72.50

NUMBER OF SOIL LAYERS =1
SOIL NO.  GAMMA     COH     PHI    DELTA
   1      120.00    0.     30.00    0.
SOIL NO 1  KA ********  KAE =  0.
WATER EL. = 84.50  ACCEL =  0.     BETA =  9.46
ELEV AT BOTTOM OF SOIL 1  = 72.50
LINE LOAD 1  MAG =  0.     DIST =  0.
MAG OF UNIF LOAD =  0.     DIST TO LEFT END =  0.     DIST TO RIGHT END =  0.

         ENTERING S/R CLASSIC FROM MODULE 8A-8P

   INPUT DATA FOR SUBROUTINE CLASSIC

   BACKFILL DESCRIPTION

   EQUIV. SURFACE SLOPE         =     9.46
   ELEVATION OF WATER SURFACE   =    84.50
   INCREMENT LENGTH             =     1.00

   BACKFILL SOIL DESCRIPTION

       FROM      TO       UNIT WT        PHI          C          KA
       (FT)     (FT)       (PCF)        (DEG)       (PSF)
    SURFACE    72.50      120.00        30.00        0.       ********

   WALL BREAK POINTS

   POINT      X-COORD   Y-COORD
    NO         (FT)      (FT)
     1         9.00     88.79
     2         9.00     72.50

   DATA FROM SUBROUTINE CLASSIC

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
   BACKFILL LAYER           KA VALUE
   ..............           ........
         1                   0.3711
         2                   0.3711

   COORDINATES AND STATIC ACTIVE SOIL PRESSURES
   FOR EACH SOIL LAYER

      COORDINATES        ACTIVE          ACTIVE
      AT WALL (FT)      PRESSURE         COEFF.
        X       Y        (PSF)
      9.00    88.79        0.         0.3711
      9.00    84.50      191.02       0.3711
      9.00    84.50      191.02       0.3711
      9.00    72.50      447.05       0.3711
```

STATIC ACTIVE SOIL FORCES

Y-COORD (FT)	SOIL FORCE (LB/FT) HORIZONTAL	VERTICAL
88.79	7.42	0.
87.79	44.53	0.
86.79	89.05	0.
85.79	133.58	0.
84.79	176.73	0.
83.79	206.08	0.
82.79	227.51	0.
81.79	248.84	0.
80.79	270.18	0.
79.79	291.51	0.
78.79	312.85	0.
77.79	334.19	0.
76.79	355.52	0.
75.79	376.86	0.
74.79	398.19	0.
73.79	419.53	0.
72.79	281.10	0.
72.50	64.52	0.

OUTPUT FROM SUBROUTINE CLASSIC

POINT NO	Y-COORD (FT)	STATIC FORCES (LB/FT) HORIZ	VERT	EARTHQUAKE FORCES (LB/FT) HORIZ	VERT
1	88.79	7.42	0.	0.	0.
2	87.79	44.53	0.	0.	0.
3	86.79	89.05	0.	0.	0.
4	85.79	133.58	0.	0.	0.
5	84.79	176.73	0.	0.	0.
6	83.79	206.08	0.	0.	0.
7	82.79	227.51	0.	0.	0.
8	81.79	248.84	0.	0.	0.
9	80.79	270.18	0.	0.	0.
10	79.79	291.51	0.	0.	0.
11	78.79	312.85	0.	0.	0.
12	77.79	334.19	0.	0.	0.
13	76.79	355.52	0.	0.	0.
14	75.79	376.86	0.	0.	0.
15	74.79	398.19	0.	0.	0.
16	73.79	419.53	0.	0.	0.
17	72.79	281.10	0.	0.	0.
18	72.50	64.52	0.	0.	0.

RESULTANTS OF STATIC SOIL AND SURCHARGE FORCES

HORIZONTAL = 4238.20 (LB/FT) AT Y = 78.49 (FT)
VERTICAL = 0. (LB/FT)

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 4
FOR CLASSIC(COULOMB) ANALYSIS IN 8A (END OF HEEL)

OUTPUT OF ARRAYS H, FH, AND YH IN MODULE 8A FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
88.790	7.4212	0.
87.790	44.527	0.
86.790	89.055	0.
85.790	133.58	0.
84.790	176.73	0.
83.790	206.08	0.
82.790	227.51	0.
81.790	248.84	0.
80.790	270.18	0.
79.790	291.51	0.
78.790	312.85	0.
77.790	334.19	0.
76.790	355.52	0.
75.790	376.86	0.
74.790	398.19	0.
73.790	419.53	0.
72.790	281.10	0.
72.500	64.524	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 4238.20 LBS/HORIZ FT
ACTING AT ELEVATION 78.49

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

```
SUM
SUMVF =    18938.2 ,SUMHF =     4238.2 ,SUMMOM =     90416.5
SCHAR
> FUNCT, YSH =   87.45801     FROM X =   1.008077
> FUNCT, YSH =   87.45747     FROM X =   1.004846
> FUNCT, YSH =   87.45721     FROM X =   1.003241
> FUNCT, YSH =   87.45707     FROM X =   1.002443
> FUNCT, YSH =   87.45701     FROM X =   1.002047
> FUNCT, YSH =   87.45701     FROM X =   1.002047
> FUNCT, YSH =   89.12367     FROM X =   11.00205
> FUNCT, YSH =   89.29034     FROM X =   12.00205
> FUNCT, YSH =   89.45701     FROM X =   13.00205
```

SURCHARGE LOADS

PVT	XDVT	PVH	XDVH
-0.12E 31	-0.12E 31	400.00	2.00
-0.12E 31	-0.12E 31	800.00	4.00
-0.12E 31	-0.12E 31	400.00	7.00
-0.12E 31	-0.12E 31	-0.12E 31	-0.12E 31
-0.12E 31	-0.12E 31	-0.12E 31	-0.12E 31

```
     TW(1)     TW(2)     TDW(1)    TDW(2)    TWW(1)    TWW(2)
   600.000-0.123E 31     -0.500-0.123E 31      3.000-0.123E 31


 X-COORDINATE OF SOIL SURFACE,XSL(1) =      0.
 Y-COORDINATE OF SOIL SURFACE,YSL(1) =     77.0000
 X-COORDINATE OF SOIL SURFACE,XSL(2) =     -2.0000
 Y-COORDINATE OF SOIL SURFACE,YSL(2) =     77.0000
 SLOPE OF SOIL SURFACE,SP            =      0.
 X-COORDINATE OF PRESSURE POINT,XPT  =     -2.0000
 Y-COORDINATE OF PRESSURE POINT,YPT  =     74.0000


 UNIFORM STRIP LOAD -
 PSTRIP
 Z1 =      1.0000       XD =      1.5000       YD =      3.0000
 WS =    600.0000       UP =    164.9445
 PSTRIP
 Z1 =      1.0000       XD =      1.5000       YD =      3.0000
 WS =    600.0000       UP =    164.9445
@x=-2: 164.9445 (from left) + 164.9445 (from right) = 329.889 psf
 X-COORDINATE OF SOIL SURFACE,XSL(1) =      0.
 Y-COORDINATE OF SOIL SURFACE,YSL(1) =     77.0000
 X-COORDINATE OF SOIL SURFACE,XSL(2) =     -2.0000
 Y-COORDINATE OF SOIL SURFACE,YSL(2) =     77.0000
 SLOPE OF SOIL SURFACE,SP            =      0.
 X-COORDINATE OF PRESSURE POINT,XPT  =     -1.0000
 Y-COORDINATE OF PRESSURE POINT,YPT  =     74.0000


 UNIFORM STRIP LOAD -
 PSTRIP
 Z1 =      1.0000       XD =      2.5000       YD =      3.0000
 WS =    600.0000       UP =    226.6127
 PSTRIP
 Z1 =      1.0000       XD =      0.5000       YD =      3.0000
 WS =    600.0000       UP =     62.5118
@x=-1: 226.6127 (from left) + 62.5118 (right side) = 289.1245 psf
XT =     -2.0000       XPT =     -1.0000        YPT =     74.0000
 PTP =       0.                  UFORMP =    289.1245
  P1 =    329.8891                   P2 =    289.1245
 XP1 =      1.0000                   X1 =      1.0000
  Z1 =      1.0000                   Z2 =      1.0000
 SWT =    509.5068           SH =      0.     SM =    460.8631
 SUM
 SUMVF =     19247.7 ,SUMHF =      4258.2 ,SUMMOM =     90877.3

X-COORDINATE OF SOIL SURFACE,XSL(1) =      0.
Y-COORDINATE OF SOIL SURFACE,YSL(1) =     77.0000
X-COORDINATE OF SOIL SURFACE,XSL(2) =     -2.0000
Y-COORDINATE OF SOIL SURFACE,YSL(2) =     77.0000
SLOPE OF SOIL SURFACE,SP            =      0.
X-COORDINATE OF PRESSURE POINT,XPT  =      0.
Y-COORDINATE OF PRESSURE POINT,YPT  =     74.0000


UNIFORM STRIP LOAD -
PSTRIP
Z1 =      1.0000       XD =      3.5000       YD =      3.0000
WS =    600.0000       UP =    229.7072
PSTRIP
Z1 =      1.0000       XD =      0.5000       YD =      3.0000
WS =    600.0000       UP =     62.5118
@x=0: 229.7072 (left) + 62.5118 (right) = 292.219 psf
XT =     -1.0000       XPT =      0.            YPT =     74.0000
```

```
PTP =      0.                UFORMP =   167.1954
 P1 =   289.1245                 P2 =   167.1954
XP1 =     2.0000                 X1 =     1.0000
 Z1 =     1.0000                 Z2 =     1.0000
SWT =   228.1600          SH =      0.      SM =    560.2391
SUM
SUMVF =      19475.9 ,SUMHF =      4238.2 ,SUMMOM =      91437.6

X-COORDINATE OF SOIL SURFACE,XS(1)   =     1.0020
Y-COORDINATE OF SOIL SURFACE,YS(1)   =    87.4570
X-COORDINATE OF SOIL SURFACE,XS(2)   =    11.0020
Y-COORDINATE OF SOIL SURFACE,YS(2)   =    89.1237
X-COORDINATE OF SOIL SURFACE,XS(3)   =    12.0020
Y-COORDINATE OF SOIL SURFACE,YS(3)   =    89.2903
X-COORDINATE OF SOIL SURFACE,XS(4)   =    13.0020
Y-COORDINATE OF SOIL SURFACE,YS(4)   =    89.4570
X-COORDINATE OF PRESSURE POINT,XPT   =     0.
Y-COORDINATE OF PRESSURE POINT,YPT   =    74.6000

SURCHARGE PRESSURE DUE TO PVH(1)     =    18.6626
      NET SURCHARGE PRESSURE,PTP     =    18.6626
SLOPE OF SOIL SURFACE,SP             =     0.1667
   X-DIST BETWEEN LOAD & PRES PT     =     2.0000
   Y-DIST BETWEEN LOAD & PRES PT     =    13.0233

SURCHARGE PRESSURE DUE TO PVH(2)     =    32.1122
      NET SURCHARGE PRESSURE,PTP     =    50.7747
SLOPE OF SOIL SURFACE,SP             =     0.1667
   X-DIST BETWEEN LOAD & PRES PT     =     4.0000
   Y-DIST BETWEEN LOAD & PRES PT     =    13.3567

SURCHARGE PRESSURE DUE TO PVH(3)     =    11.6642
      NET SURCHARGE PRESSURE,PTP     =    62.4389
SLOPE OF SOIL SURFACE,SP             =     0.1667
   X-DIST BETWEEN LOAD & PRES PT     =     7.0000
   Y-DIST BETWEEN LOAD & PRES PT     =    13.8567


X-COORDINATE OF SOIL SURFACE,XS(1)   =     1.0020
Y-COORDINATE OF SOIL SURFACE,YS(1)   =    87.4570
X-COORDINATE OF SOIL SURFACE,XS(2)   =    11.0020
Y-COORDINATE OF SOIL SURFACE,YS(2)   =    89.1237
X-COORDINATE OF SOIL SURFACE,XS(3)   =    12.0020
Y-COORDINATE OF SOIL SURFACE,YS(3)   =    89.2903
X-COORDINATE OF SOIL SURFACE,XS(4)   =    13.0020
Y-COORDINATE OF SOIL SURFACE,YS(4)   =    89.4570
X-COORDINATE OF PRESSURE POINT,XPT   =     1.0000
Y-COORDINATE OF PRESSURE POINT,YPT   =    74.5333

SURCHARGE PRESSURE DUE TO PVH(1)     =    19.2285
      NET SURCHARGE PRESSURE,PTP     =    19.2285
SLOPE OF SOIL SURFACE,SP             =     0.1667
   X-DIST BETWEEN LOAD & PRES PT     =     1.0000
   Y-DIST BETWEEN LOAD & PRES PT     =    13.0900

SURCHARGE PRESSURE DUE TO PVH(2)     =    34.4171
      NET SURCHARGE PRESSURE,PTP     =    53.6456
SLOPE OF SOIL SURFACE,SP             =     0.1667
   X-DIST BETWEEN LOAD & PRES PT     =     3.0000
   Y-DIST BETWEEN LOAD & PRES PT     =    13.4233
```

```
SURCHARGE PRESSURE DUE TO PVH(3)         =     13.0091
      NET SURCHARGE PRESSURE,PTP         =     66.6547
SLOPE OF SOIL SURFACE,SP                 =      0.1667
   X-DIST BETWEEN LOAD & PRES PT         =      6.0000
   Y-DIST BETWEEN LOAD & PRES PT         =     13.9233


XT =        0.           XPT =      1.0000       YPT =     74.5333
 PTP =     66.6547            UFORMP =       0.
  P1 =    167.1954                P2 =     66.6547
 XP1 =      3.0000                X1 =      1.0000
  Z1 =      1.0000                Z2 =      1.0000
 SWT =    116.9250         SH =        0.      SM =   400.8592
 SUM
 SUMVF =     19592.8 ,SUMHF =      4238.2 ,SUMMOM =     91838.4
 X-COORDINATE OF SOIL SURFACE,XS(1)  =      1.0020
 Y-COORDINATE OF SOIL SURFACE,YS(1)  =     87.4570
 X-COORDINATE OF SOIL SURFACE,XS(2)  =     11.0020
 Y-COORDINATE OF SOIL SURFACE,YS(2)  =     89.1237
 X-COORDINATE OF SOIL SURFACE,XS(3)  =     12.0020
 Y-COORDINATE OF SOIL SURFACE,YS(3)  =     89.2903
 X-COORDINATE OF SOIL SURFACE,XS(4)  =     13.0020
 Y-COORDINATE OF SOIL SURFACE,YS(4)  =     89.4570
 X-COORDINATE OF PRESSURE POINT,XPT  =      2.0000
 Y-COORDINATE OF PRESSURE POINT,YPT  =     74.4667


SURCHARGE PRESSURE DUE TO PVH(1)         =     19.3550
      NET SURCHARGE PRESSURE,PTP         =     19.3550
SLOPE OF SOIL SURFACE,SP                 =      0.1667
   X-DIST BETWEEN LOAD & PRES PT         =      0.
   Y-DIST BETWEEN LOAD & PRES PT         =     13.1567


SURCHARGE PRESSURE DUE TO PVH(2)         =     36.1471
      NET SURCHARGE PRESSURE,PTP         =     55.5021
SLOPE OF SOIL SURFACE,SP                 =      0.1667
   X-DIST BETWEEN LOAD & PRES PT         =      2.0000
   Y-DIST BETWEEN LOAD & PRES PT         =     13.4900


SURCHARGE PRESSURE DUE TO PVH(3)         =     14.3123
      NET SURCHARGE PRESSURE,PTP         =     69.8144
SLOPE OF SOIL SURFACE,SP                 =      0.1667
   X-DIST BETWEEN LOAD & PRES PT         =      5.0000
   Y-DIST BETWEEN LOAD & PRES PT         =     13.9900


XT =      1.0000         XPT =      2.0000       YPT =     74.4667
 PTP =     69.8144            UFORMP =       0.
  P1 =    167.1954                P2 =     69.8144
 XP1 =      4.0000                X1 =      1.0000
  Z1 =      1.0000                Z2 =      1.0000
 SWT =    118.5049         SH =        0.      SM =   525.1570
 SUM
 SUMVF =     19711.5 ,SUMHF =      4238.2 ,SUMMOM =     92363.6


 X-COORDINATE OF SOIL SURFACE,XS(1)  =      1.0020
 Y-COORDINATE OF SOIL SURFACE,YS(1)  =     87.4570
 X-COORDINATE OF SOIL SURFACE,XS(2)  =     11.0020
 Y-COORDINATE OF SOIL SURFACE,YS(2)  =     89.1237
 X-COORDINATE OF SOIL SURFACE,XS(3)  =     12.0020
 Y-COORDINATE OF SOIL SURFACE,YS(3)  =     89.2903
 X-COORDINATE OF SOIL SURFACE,XS(4)  =     13.0020
 Y-COORDINATE OF SOIL SURFACE,YS(4)  =     89.4570
 X-COORDINATE OF PRESSURE POINT,XPT  =      3.0000
 Y-COORDINATE OF PRESSURE POINT,YPT  =     74.4000
```

```
SURCHARGE PRESSURE DUE TO PVH(1)      =     19.0391
      NET SURCHARGE PRESSURE,PTP      =     19.0391
SLOPE OF SOIL SURFACE,SP              =      0.1667
   X-DIST BETWEEN LOAD & PRES PT      =      1.0000
   Y-DIST BETWEEN LOAD & PRES PT      =     13.2233

SURCHARGE PRESSURE DUE TO PVH(2)      =     37.1624
      NET SURCHARGE PRESSURE,PTP      =     56.2015
SLOPE OF SOIL SURFACE,SP              =      0.1667
   X-DIST BETWEEN LOAD & PRES PT      =      1.0000
   Y-DIST BETWEEN LOAD & PRES PT      =     13.5567

SURCHARGE PRESSURE DUE TO PVH(3)      =     15.5034
      NET SURCHARGE PRESSURE,PTP      =     71.7048
SLOPE OF SOIL SURFACE,SP              =      0.1667
   X-DIST BETWEEN LOAD & PRES PT      =      4.0000
   Y-DIST BETWEEN LOAD & PRES PT      =     14.0567

XT =      2.0000      XPT =      3.0000       YPT =     74.4000
PTP =     71.7048          UFORMP =      0.
 P1 =    167.1954              P2 =     71.7048
XP1 =      5.0000              X1 =      1.0000
 Z1 =      1.0000              Z2 =      1.0000
SWT =    119.4501          SH =      0.     SM =    649.0181
SUM
SUMVF =      9830.7 ,SUMHF =      4238.2 ,SUMMOM =      93012.6

X-COORDINATE OF SOIL SURFACE,XS(1)    =      1.0020
Y-COORDINATE OF SOIL SURFACE,YS(1)    =     87.4570
X-COORDINATE OF SOIL SURFACE,XS(2)    =     11.0020
Y-COORDINATE OF SOIL SURFACE,YS(2)    =     89.1237
X-COORDINATE OF SOIL SURFACE,XS(3)    =     12.0020
Y-COORDINATE OF SOIL SURFACE,YS(3)    =     89.2903
X-COORDINATE OF SOIL SURFACE,XS(4)    =     13.0020
Y-COORDINATE OF SOIL SURFACE,YS(4)    =     89.4570
X-COORDINATE OF PRESSURE POINT,XPT    =      4.0000
Y-COORDINATE OF PRESSURE POINT,YPT    =     74.3333

SURCHARGE PRESSURE DUE TO PVH(1)      =     18.3216
      NET SURCHARGE PRESSURE,PTP      =     18.3216
SLOPE OF SOIL SURFACE,SP              =      0.1667
   X-DIST BETWEEN LOAD & PRES PT      =      2.0000
   Y-DIST BETWEEN LOAD & PRES PT      =     13.2900

SURCHARGE PRESSURE DUE TO PVH(2)      =     37.3841
      NET SURCHARGE PRESSURE,PTP      =     55.7057
SLOPE OF SOIL SURFACE,SP              =      0.1667
   X-DIST BETWEEN LOAD & PRES PT      =      0.
   Y-DIST BETWEEN LOAD & PRES PT      =     13.6233

SURCHARGE PRESSURE DUE TO PVH(3)      =     16.5071
      NET SURCHARGE PRESSURE,PTP      =     72.2128
SLOPE OF SOIL SURFACE,SP              =      0.1667
   X-DIST BETWEEN LOAD & PRES PT      =      3.0000
   Y-DIST BETWEEN LOAD & PRES PT      =     14.1233
```

```
XT =      3.0000      XPT =      4.0000      YPT =     74.3333
 PTP =     72.2128           UFORMP =      0.
  P1 =    167.1954              P2 =     72.2128
 XP1 =      6.0000              X1 =      1.0000
  Z1 =      1.0000              Z2 =      1.0000
 SWT =    119.7041          SH =      0.      SM =    770.1614
 SUM
 SUMVF =      19950.4 ,SUMHF =      4238.2 ,SUMMOM =     93782.8

 X-COORDINATE OF SOIL SURFACE,XS(1)   =      1.0020
 Y-COORDINATE OF SOIL SURFACE,YS(1)   =     87.4570
 X-COORDINATE OF SOIL SURFACE,XS(2)   =     11.0020
 Y-COORDINATE OF SOIL SURFACE,YS(2)   =     89.1237
 X-COORDINATE OF SOIL SURFACE,XS(3)   =     12.0020
 Y-COORDINATE OF SOIL SURFACE,YS(3)   =     89.2903
 X-COORDINATE OF SOIL SURFACE,XS(4)   =     13.0020
 Y-COORDINATE OF SOIL SURFACE,YS(4)   =     89.4570
 X-COORDINATE OF PRESSURE POINT,XPT   =      5.0000
 Y-COORDINATE OF PRESSURE POINT,YPT   =     74.2667

 SURCHARGE PRESSURE DUE TO PVH(1)     =     17.2780
       NET SURCHARGE PRESSURE,PTP     =     17.2780
 SLOPE OF SOIL SURFACE,SP             =      0.1667
    X-DIST BETWEEN LOAD & PRES PT     =      3.0000
    Y-DIST BETWEEN LOAD & PRES PT     =     13.3567

 SURCHARGE PRESSURE DUE TO PVH(2)     =     36.8082
       NET SURCHARGE PRESSURE,PTP     =     54.0862
 SLOPE OF SOIL SURFACE,SP             =      0.1667
    X-DIST BETWEEN LOAD & PRES PT     =      1.0000
    Y-DIST BETWEEN LOAD & PRES PT     =     13.6900

 SURCHARGE PRESSURE DUE TO PVH(3)     =     17.2533
       NET SURCHARGE PRESSURE,PTP     =     71.3395
 SLOPE OF SOIL SURFACE,SP             =      0.1667
    X-DIST BETWEEN LOAD & PRES PT     =      2.0000
    Y-DIST BETWEEN LOAD & PRES PT     =     14.1900
XT =      4.0000      XPT =      5.0000      YPT =     74.2667
 PTP =     71.3395           UFORMP =      0.
  P1 =    167.1954              P2 =     71.3395
 XP1 =      7.0000              X1 =      1.0000
  Z1 =      1.0000              Z2 =      1.0000
 SWT =    119.2678          SH =      0.      SM =    886.5177
 SUM
 SUMVF =      20069.7 ,SUMHF =      4238.2 ,SUMMOM =     94669.3

 X-COORDINATE OF SOIL SURFACE,XS(1)   =      1.0020
 Y-COORDINATE OF SOIL SURFACE,YS(1)   =     87.4570
 X-COORDINATE OF SOIL SURFACE,XS(2)   =     11.0020
 Y-COORDINATE OF SOIL SURFACE,YS(2)   =     89.1237
 X-COORDINATE OF SOIL SURFACE,XS(3)   =     12.0020
 Y-COORDINATE OF SOIL SURFACE,YS(3)   =     89.2903
 X-COORDINATE OF SOIL SURFACE,XS(4)   =     13.0020
 Y-COORDINATE OF SOIL SURFACE,YS(4)   =     89.4570
 X-COORDINATE OF PRESSURE POINT,XPT   =      6.0000
 Y-COORDINATE OF PRESSURE POINT,YPT   =     74.2000

 SURCHARGE PRESSURE DUE TO PVH(1)     =     16.0024
       NET SURCHARGE PRESSURE,PTP     =     16.0024
 SLOPE OF SOIL SURFACE,SP             =      0.1667
    X-DIST BETWEEN LOAD & PRES PT     =      4.0000
    Y-DIST BETWEEN LOAD & PRES PT     =     13.4233
```

```
SURCHARGE PRESSURE DUE TO PVH(2)     =    35.5050
      NET SURCHARGE PRESSURE,PTP     =    51.5074
SLOPE OF SOIL SURFACE,SP             =     0.1667
   X-DIST BETWEEN LOAD & PRES PT     =     2.0000
   Y-DIST BETWEEN LOAD & PRES PT     =    13.7567


SURCHARGE PRESSURE DUE TO PVH(3)     =    17.6872
      NET SURCHARGE PRESSURE,PTP     =    69.1946
SLOPE OF SOIL SURFACE,SP             =     0.1667
   X-DIST BETWEEN LOAD & PRES PT     =     1.0000
   Y-DIST BETWEEN LOAD & PRES PT     =    14.2567


XT =      5.0000      XPT =      6.0000       YPT =     74.2000
 PTP =     69.1946          UFORMP =      0.
  P1 =    167.1954               P2 =    69.1946
 XP1 =      8.0000               X1 =     1.0000
  Z1 =      1.0000               Z2 =     1.0000
 SWT =    118.1950          SH =       0.     SM =    996.4908
 SUM
 SUMVF =     20187.9 ,SUMHF =      4238.2 ,SUMMOM =     95665.8


X-COORDINATE OF SOIL SURFACE,XS(1)  =     1.0020
Y-COORDINATE OF SOIL SURFACE,YS(1)  =    87.4570
X-COORDINATE OF SOIL SURFACE,XS(2)  =    11.0020
Y-COORDINATE OF SOIL SURFACE,YS(2)  =    89.1237
X-COORDINATE OF SOIL SURFACE,XS(3)  =    12.0020
Y-COORDINATE OF SOIL SURFACE,YS(3)  =    89.2903
X-COORDINATE OF SOIL SURFACE,XS(4)  =    13.0020
Y-COORDINATE OF SOIL SURFACE,YS(4)  =    89.4570
X-COORDINATE OF PRESSURE POINT,XPT  =     7.0000
Y-COORDINATE OF PRESSURE POINT,YPT  =    74.1333


SURCHARGE PRESSURE DUE TO PVH(1)     =    14.5921
      NET SURCHARGE PRESSURE,PTP     =    14.5921
SLOPE OF SOIL SURFACE,SP             =     0.1667
   X-DIST BETWEEN LOAD & PRES PT     =     5.0000
   Y-DIST BETWEEN LOAD & PRES PT     =    13.4900


SURCHARGE PRESSURE DUE TO PVH(2)     =    33.6033
      NET SURCHARGE PRESSURE,PTP     =    48.1954
SLOPE OF SOIL SURFACE,SP             =     0.1667
   X-DIST BETWEEN LOAD & PRES PT     =     3.0000
   Y-DIST BETWEEN LOAD & PRES PT     =    13.8233


SURCHARGE PRESSURE DUE TO PVH(3)     =    17.7785
      NET SURCHARGE PRESSURE,PTP     =    65.9739
SLOPE OF SOIL SURFACE,SP             =     0.1667
   X-DIST BETWEEN LOAD & PRES PT     =     0.
   Y-DIST BETWEEN LOAD & PRES PT     =    14.3233


XT =      6.0000      XPT =      7.0000       YPT =     74.1333
 PTP =     65.9739          UFORMP =      0.
  P1 =    167.1954               P2 =    65.9739
 XP1 =      9.0000               X1 =     1.0000
  Z1 =      1.0000               Z2 =     1.0000
 SWT =    116.5847          SH =       0.     SM =   1099.1192
 SUM
 SUMVF =     20304.5 ,SUMHF =      4238.2 ,SUMMOM =     96764.9
```

```
X-COORDINATE OF SOIL SURFACE,XS(1)  =     1.0020
Y-COORDINATE OF SOIL SURFACE,YS(1)  =    87.4570
X-COORDINATE OF SOIL SURFACE,XS(2)  =    11.0020
Y-COORDINATE OF SOIL SURFACE,YS(2)  =    89.1237
X-COORDINATE OF SOIL SURFACE,XS(3)  =    12.0020
Y-COORDINATE OF SOIL SURFACE,YS(3)  =    89.2903
X-COORDINATE OF SOIL SURFACE,XS(4)  =    13.0020
Y-COORDINATE OF SOIL SURFACE,YS(4)  =    89.4570
X-COORDINATE OF PRESSURE POINT,XPT  =     8.0000
Y-COORDINATE OF PRESSURE POINT,YPT  =    74.0667

SURCHARGE PRESSURE DUE TO PVH(1)    =    13.1344
      NET SURCHARGE PRESSURE,PTP    =    13.1344
SLOPE OF SOIL SURFACE,SP            =     0.1667
   X-DIST BETWEEN LOAD & PRES PT    =     6.0000
   Y-DIST BETWEEN LOAD & PRES PT    =    13.5567

SURCHARGE PRESSURE DUE TO PVH(2)    =    31.2656
      NET SURCHARGE PRESSURE,PTP    =    44.4000
SLOPE OF SOIL SURFACE,SP            =     0.1667
   X-DIST BETWEEN LOAD & PRES PT    =     4.0000
   Y-DIST BETWEEN LOAD & PRES PT    =    13.8900

SURCHARGE PRESSURE DUE TO PVH(3)    =    17.5265
      NET SURCHARGE PRESSURE,PTP    =    61.9265
SLOPE OF SOIL SURFACE,SP            =     0.1667
   X-DIST BETWEEN LOAD & PRES PT    =     1.0000
   Y-DIST BETWEEN LOAD & PRES PT    =    14.3900

XT =      7.0000       XPT =      8.0000       YPT =     74.0667
 PTP =     61.9265          UFORMP =     0.
  P1 =    167.1954              P2 =    61.9265
 XP1 =     10.0000              X1 =     1.0000
  Z1 =      1.0000              Z2 =     1.0000
 SWT =    114.5609          SH =      0.     SM =  1194.1173
 SUM
 SUMVF =     20419.0 ,SUMHF =     4238.2 ,SUMMOM =     97959.0

X-COORDINATE OF SOIL SURFACE,XS(1)  =     1.0020
Y-COORDINATE OF SOIL SURFACE,YS(1)  =    87.4570
X-COORDINATE OF SOIL SURFACE,XS(2)  =    11.0020
Y-COORDINATE OF SOIL SURFACE,YS(2)  =    89.1237
X-COORDINATE OF SOIL SURFACE,XS(3)  =    12.0020
Y-COORDINATE OF SOIL SURFACE,YS(3)  =    89.2903
X-COORDINATE OF SOIL SURFACE,XS(4)  =    13.0020
Y-COORDINATE OF SOIL SURFACE,YS(4)  =    89.4570
X-COORDINATE OF PRESSURE POINT,XPT  =     9.0000
Y-COORDINATE OF PRESSURE POINT,YPT  =    74.0000

SURCHARGE PRESSURE DUE TO PVH(1)    =    11.6991
      NET SURCHARGE PRESSURE,PTP    =    11.6991
SLOPE OF SOIL SURFACE,SP            =     0.1667
   X-DIST BETWEEN LOAD & PRES PT    =     7.0000
   Y-DIST BETWEEN LOAD & PRES PT    =    13.6233

SURCHARGE PRESSURE DUE TO PVH(2)    =    28.6619
      NET SURCHARGE PRESSURE,PTP    =    40.3610
SLOPE OF SOIL SURFACE,SP            =     0.1667
   X-DIST BETWEEN LOAD & PRES PT    =     5.0000
   Y-DIST BETWEEN LOAD & PRES PT    =    13.9567
```

```
SURCHARGE PRESSURE DUE TO PVH(S)    =    16.9592
     NET SURCHARGE PRESSURE,PTP     =    57.3202
SLOPE OF SOIL SURFACE,SP            =     0.1667
   X-DIST BETWEEN LOAD & PRES PT    =     2.0000
   Y-DIST BETWEEN LOAD & PRES PT    =    14.4567


XT =      8.0000      XPT =      9.0000      YPT =    74.0000
 PTP =    57.3202          UFORMP =      0.
  P1 =   167.1954              P2 =    57.3202
 XP1 =    11.0000              X1 =     1.0000
  Z1 =     1.0000              Z2 =     1.0000
 SWT =   112.2578         SH =      0.     BM =  1281.8083
SUM
SUMVF =     20531.3 ,SUMHF =      4238.2 ,SUMMOM =      99240.8
PONSTR



LC =  4

> PWIND ENTERED, W(LC) =  -0.123400E 31
  WIND F, M =    0.                0.            SUMMATION FOLLOWS--
SUM
SUMVF =     20531.3 ,SUMHF =      4238.2 ,SUMMOM =      99240.8

> ENTER EARTHQ FOR LOAD CASE  4--
  RKH, RKV =    0.              -0.123400E 31

> SUBROUTINE VCNR ENTERED FOR LOAD CASE  4
  SOIL LAYER 7 AREA, AY =     6.00000         453.000
    X-COORDINATE + Y-COORDINATE
      -2.00000        74.0000
      0.              74.0000
      0.              74.0000
      0.              77.0000
      -2.00000        77.0000
  CONCRETE OUTLINE AREA, AY =     35.3750         2712.58
  SOIL LAYER 1 AREA, AY =     107.599         8748.57
    X-COORDINATE + Y-COORDINATE
      9.00000         74.0000
      9.00000         88.7886
      1.00172         87.4553
      1.50000         74.5000
  SUMA(WEIGHT)  AT YC(ELEVATION) = MOMENT
   18938.2          79.7646         0.151060E 07
  HORIZONTAL INERTIAL  FORCE AT ELEV. YC =     79.7646     --
     SWT VERT FORCE, SH HORIZ FORCE, MOMENT
        0.               0.               0.


SUM
SUMVF =     20531.3 ,SUMHF =      4238.2 ,SUMMOM =      99240.8

> ENTERING S/R WESWAT WITH LC, YZERO, NSIDE =  4     78.50****
   COMPUTED FSUM, XMSUM =    0.              0.
  S/R WESWAT TRACE ABOVE IS FOR WESTERGAARD WATER
SUM
SUMVF =     20531.3 ,SUMHF =      4238.2 ,SUMMOM =      99240.8
  END OF S/R EARTHQ
```

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W8 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 4

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	5306.25	0.	22028.13
ACTIVE EARTH	0.	4238.20	-25401.20
SOIL+WATER	13631.94	0.	93789.52
SURCHARGES	1593.12	0.	8824.35
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	20531.31	4238.20	99240.80

ANALYSIS OF COMPLEX RETAINING WALL
11:18:14 ON 10/ 1/80

```
#
# BEGIN THE OVERTURNING COMPUTATION
#
```

LOAD CASE 3

DEFAULT VALUE OF 1 USED FOR ISFT(LC) (LOAD CASE 3)

CREEP PATH DESCRIPTION FOR LOAD CASE 3

X-COORDINATES	Y-COORDINATES	HYDROSTATIC PRESSURE
9.00	84.50	0.
9.00	72.50	545.45
-2.00	72.50	357.95
-2.00	77.00	0.

OVERTURNING HYDRAULIC GRADIENT = 0.2727

DEFAULT VALUE OF 3 USED FOR NPPD(LC) (LOAD CASE 3)

> VALUE OF ADHS3 FOUND = 0. IN S/R CHEKRT (LOAD CASE 3)

> VALUE OF PHIS3 FOUND = 18.00000 IN S/R CHEKRT (LOAD CASE 3)

> VALUE OF ADHS4 FOUND = 0. IN S/R CHEKRT (LOAD CASE 3)

> VALUE OF ADHS5 FOUND = 0. IN S/R CHEKRT (LOAD CASE 3)

> VALUE OF PHIS4 FOUND = 0. IN S/R CHEKRT (LOAD CASE 3)

> VALUE OF PHIS5 FOUND = 0. IN S/R CHEKRT (LOAD CASE 3)

AT BASE-SOIL INTERFACE:

WEIGHTED AVERAGE COEFFICIENT OF FRICTION	=	0.32	
WEIGHTED AVERAGE ADHESION	=	0.	(LBS/SQ.FT)
EFFECTIVE BASE WIDTH	=	11.00	(FEET)
EFFECTIVE LENGTH ALONG BASE SLOPE	=	11.00	(FEET)
NORMAL FORCE ACTING ON BASE	=	13969.44	(LBS/SLICE)
FRICTIONAL FORCE	=	4538.95	(LBS/SLICE)
FORCE DUE TO ADHESION	=	0.	(LBS/SLICE)
TOTAL FORCE ALONG BASE	=	4538.95	(LBS/SLICE)
HORIZONTAL COMPONENT OF TOTAL FORCE	=	4538.95	(LBS/SLICE)

```
PASSIVE EARTH PRESSURES FOR LOAD CASE  3

NPPD                                     =          3
ELEVATION OF TOP OF SOIL                 =    77.020       (FT)
PRESSURE AT TOP OF SOIL                  =   0.            (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL        =    72.500       (FT)
PRESSURE AT LOWEST POINT ON WALL         =   -958.67       (LBS/SQ.FT)
PASSIVE EARTH FORCE                      =   -2166.6       (LBS/SLICE)
PASSIVE EARTH MOMENT                     =    3264.3       (FT-LBS/SLICE)

RESULTANT IS WITHIN THE KERN


CREEP PATH DESCRIPTION FOR LOAD CASE 3

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
    9.00               84.50                    0.
    9.00               72.50                  545.45
   -2.00               72.50                  357.95
   -2.00               77.00                    0.

 OVERTURNING HYDRAULIC GRADIENT  =  0.2727


 > VALUE OF NPPD(LC)     FOUND =            3      IN S/R CHEKIT (LOAD CASE  3)

 > VALUE OF ADHS3        FOUND =    0.             IN S/R CHEKRT (LOAD CASE  3)

 > VALUE OF PHIS3        FOUND =     18.00000      IN S/R CHEKRT (LOAD CASE  3)

 > VALUE OF ADHS4        FOUND =    0.             IN S/R CHEKRT (LOAD CASE  3)

 > VALUE OF ADHS5        FOUND =    0.             IN S/R CHEKRT (LOAD CASE  3)

 > VALUE OF PHIS4        FOUND =    0.             IN S/R CHEKRT (LOAD CASE  3)

 > VALUE OF PHIS5        FOUND =    0.             IN S/R CHEKRT (LOAD CASE  3)


   AT BASE-SOIL INTERFACE:
     WEIGHTED AVERAGE COEFFICIENT OF FRICTION =         0.32
     WEIGHTED AVERAGE ADHESION                =         0.    (LBS/SQ.FT)
     EFFECTIVE BASE WIDTH                     =        11.00  (FEET)
     EFFECTIVE LENGTH ALONG BASE SLOPE        =        11.00  (FEET)
     NORMAL FORCE ACTING ON BASE              =     13969.44  (LBS/SLICE)
     FRICTIONAL FORCE                         =      4538.95  (LBS/SLICE)
     FORCE DUE TO ADHESION                    =         0.    (LBS/SLICE)
     TOTAL FORCE ALONG BASE                   =      4538.95  (LBS/SLICE)
     HORIZONTAL COMPONENT OF TOTAL FORCE      =      4538.95  (LBS/SLICE)


PASSIVE EARTH PRESSURES FOR LOAD CASE  3

NPPD                                     =          3
ELEVATION OF TOP OF SOIL                 =    77.020       (FT)
PRESSURE AT TOP OF SOIL                  =   0.            (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL        =    72.500       (FT)
PRESSURE AT LOWEST POINT ON WALL         =   -958.67       (LBS/SQ.FT)
PASSIVE EARTH FORCE                      =   -2166.6       (LBS/SLICE)
PASSIVE EARTH MOMENT                     =    3264.3       (FT-LBS/SLICE)
```

```
DISTANCE FROM THE TOE TO THE RESULTANT           =  3.76 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE    =    -4968.75 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES    =     2467.33 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES   =   -41101.56 (FT-LBS/SLICE)

THE RESULTANT RATIO =        0.3422, FOR LOAD CASE  3


     LOAD CASE   4


 DEFAULT VALUE OF              1       USED FOR ISFT(LC)    (LOAD CASE  4)

CREEP PATH DESCRIPTION FOR LOAD CASE 4

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
    9.00              84.50                     0.
    9.00              72.50                   545.45
   -2.00              72.50                   357.95
   -2.00              77.00                     0.

 OVERTURNING HYDRAULIC GRADIENT  =  0.2727


 DEFAULT VALUE OF              3       USED FOR NPPD(LC)    (LOAD CASE  4)

 > VALUE OF ADHS3        FOUND =    0.             IN S/R CHEKRT (LOAD CASE  4)

 > VALUE OF PHIS3        FOUND =    18.00000       IN S/R CHEKRT (LOAD CASE  4)

 > VALUE OF ADHS4        FOUND =    0.             IN S/R CHEKRT (LOAD CASE  4)

 > VALUE OF ADHS5        FOUND =    0.             IN S/R CHEKRT (LOAD CASE  4)

 > VALUE OF PHIS4        FOUND =    0.             IN S/R CHEKRT (LOAD CASE  4)

 > VALUE OF PHIS5        FOUND =    0.             IN S/R CHEKRT (LOAD CASE  4)


   AT BASE-SOIL INTERFACE:
     WEIGHTED AVERAGE COEFFICIENT OF FRICTION =          0.32
     WEIGHTED AVERAGE ADHESION                =          0.    (LBS/SQ.FT)
     EFFECTIVE BASE WIDTH                     =         11.00  (FEET)
     EFFECTIVE LENGTH ALONG BASE SLOPE        =         11.00  (FEET)
     NORMAL FORCE ACTING ON BASE              =      15562.56  (LBS/SLICE)
     FRICTIONAL FORCE                         =       5056.58  (LBS/SLICE)
     FORCE DUE TO ADHESION                    =          0.    (LBS/SLICE)
     TOTAL FORCE ALONG BASE                   =       5056.58  (LBS/SLICE)
     HORIZONTAL COMPONENT OF TOTAL FORCE      =       5056.58  (LBS/SLICE)
```

```
PASSIVE EARTH PRESSURES FOR LOAD CASE  4

NPPD                                    =          3
ELEVATION OF TOP OF SOIL                =   77.020      (FT)
PRESSURE AT TOP OF SOIL                 =  0.           (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL       =   72.500      (FT)
PRESSURE AT LOWEST POINT ON WALL        =  -729.62      (LBS/SQ.FT)
PASSIVE EARTH FORCE                     =  -1648.9      (LBS/SLICE)
PASSIVE EARTH MOMENT                    =   2484.4      (FT-LBS/SLICE)

RESULTANT IS WITHIN THE KERN


CREEP PATH DESCRIPTION FOR LOAD CASE 4


X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
    9.00               84.50                   0.
    9.00               72.50                 545.45
   -2.00               72.50                 357.95
   -2.00               77.00                   0.

OVERTURNING HYDRAULIC GRADIENT  =  0.2727


> VALUE OF NPPD(LC)    FOUND =          3      IN S/R CHEKIT (LOAD CASE  4)

> VALUE OF ADHS3       FOUND =   0.            IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF PHIS3       FOUND =    18.00000     IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF ADHS4       FOUND =   0.            IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF ADHS5       FOUND =   0.            IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF PHIS4       FOUND =   0.            IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF PHIS5       FOUND =   0.            IN S/R CHEKRT (LOAD CASE  4)


  AT BASE-SOIL INTERFACE:
    WEIGHTED AVERAGE COEFFICIENT OF FRICTION =        0.32
    WEIGHTED AVERAGE ADHESION                =        0.   (LBS/SQ.FT)
    EFFECTIVE BASE WIDTH                     =     11.00 (FEET)
    EFFECTIVE LENGTH ALONG BASE SLOPE        =     11.00 (FEET)
    NORMAL FORCE ACTING ON BASE              =  15562.56 (LBS/SLICE)
    FRICTIONAL FORCE                         =   5056.58 (LBS/SLICE)
    FORCE DUE TO ADHESION                    =      0.   (LBS/SLICE)
    TOTAL FORCE ALONG BASE                   =   5056.58 (LBS/SLICE)
    HORIZONTAL COMPONENT OF TOTAL FORCE      =   5056.58 (LBS/SLICE)


PASSIVE EARTH PRESSURES FOR LOAD CASE  4

NPPD                                    =          3
ELEVATION OF TOP OF SOIL                =   77.020      (FT)
PRESSURE AT TOP OF SOIL                 =  0.           (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL       =   72.500      (FT)
PRESSURE AT LOWEST POINT ON WALL        =  -729.62      (LBS/SQ.FT)
PASSIVE EARTH FORCE                     =  -1648.9      (LBS/SLICE)
PASSIVE EARTH MOMENT                    =   2484.4      (FT-LBS/SLICE)
```

```
DISTANCE FROM THE TOE TO THE RESULTANT          =  3.90 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE    =     -4968.75 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES    =      2467.33 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES   =    -41101.56 (FT-LBS/SLICE)

THE RESULTANT RATIO =        0.3541, FOR LOAD CASE  4


*
* BEGIN SLIDING COMPUTATION
*
```

```
ANALYSIS OF COMPLEX RETAINING WALL
        11:18:15 ON 10/ 1/80


*
* BEGIN SLIDING COMPUTATION
*



CREEP PATH DESCRIPTION FOR LOAD CASE 3


X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
    9.00               84.50                  0.
    9.00               72.50                545.45
   -2.00               72.50                357.95
   -2.00               77.00                  0.

HYDRAULIC GRADIENT  =  0.2727


HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES =      2467.33
VERTICAL FORCE DUE TO HYDRSTATIC PRESSURES    =     -4968.75
MOMENT DUE TO THE HYDROSTATIC PRESSURES       =    -41101.56

     INTERMEDIATE FACTOR OF SAFETY =      0.94

     SUM OF DRIVING FORCES  =  6705.529 (LBS/SLICE)
     SUM OF RESISTING FORCES =  6284.700 (LBS/SLICE)

     PASSIVE EARTH FORCE                     =    1745.75 (LBS/SLICE)
     ACTIVE EARTH FORCE                      =    4238.20 (LBS/SLICE)
     UPLIFT FORCE                            =   -4968.75 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =       2467.33 (LBS/SLICE)


      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
          X           Y
        -2.00       72.50
         9.00       72.50

 FINAL FACTOR OF SAFETY AGAINST SLIDING =      0.94, FOR LOAD CASE  3
 BY SHEAR FRICTION METHOD

     SUM OF DRIVING FORCES  =  6705.529 (LBS/SLICE)
     SUM OF RESISTING FORCES =  6284.700 (LBS/SLICE)

     PASSIVE EARTH FORCE                     =    1745.75 (LBS/SLICE)
     ACTIVE EARTH FORCE                      =    4238.20 (LBS/SLICE)
     UPLIFT FORCE                            =   -4968.75 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =       2467.33 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
          X           Y
        -2.00       72.50
         9.00       72.50
```

```
CREEP PATH DESCRIPTION FOR LOAD CASE 4

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
    9.00              84.50                    0.
    9.00              72.50                  545.45
   -2.00              72.50                  357.95
   -2.00              77.00                    0.

HYDRAULIC GRADIENT  =  0.2727


HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES =      2467.33
VERTICAL FORCE DUE TO HYDRSTATIC PRESSURES    =     -4968.75
MOMENT DUE TO THE HYDROSTATIC PRESSURES       =    -41101.56

     INTERMEDIATE FACTOR OF SAFETY =      1.01

     SUM OF DRIVING FORCES   =  6705.529 (LBS/SLICE)
     SUM OF RESISTING FORCES =  6802.335 (LBS/SLICE)

     PASSIVE EARTH FORCE                        =   1745.75 (LBS/SLICE)
     ACTIVE EARTH FORCE                         =   4238.20 (LBS/SLICE)
     UPLIFT FORCE                               =  -4968.75 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =   2467.33 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
          X           Y
        -2.00       72.50
         9.00       72.50


 FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.01, FOR LOAD CASE  4
 BY SHEAR FRICTION METHOD

     SUM OF DRIVING FORCES   =  6705.529 (LBS/SLICE)
     SUM OF RESISTING FORCES =  6802.335 (LBS/SLICE)

     PASSIVE EARTH FORCE                        =   1745.75 (LBS/SLICE)
     ACTIVE EARTH FORCE                         =   4238.20 (LBS/SLICE)
     UPLIFT FORCE                               =  -4968.75 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =   2467.33 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
          X           Y
        -2.00       72.50
         9.00       72.50
```

ANALYSIS OF COMPLEX RETAINING WALL
11:18:17 ON 10/ 1/80

```
#
#  BEGIN ALLOWABLE BEARING CAPACITY COMPUTATIONS
#

 > ELTS4       FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

 > ELTS3       FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

 > ABP3TN      FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

 > ABP3HN      FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

 > ABP3TW      FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

 > ELBS3       FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

ELBS3 SET TO 10 FEET BELOW LOWEST POINT ON BASE

 ALLOWABLE BEARING PRESSURES WILL NOT BE COMPARED
 TO THE ACTUAL BEARING PRESSURES BECAUSE THE ALLOWABLES WERE NOT DEFINED.


 FOR LOAD CASE  3,

 FOR THE BASE COORDINATES  X= -2.00  Y= 72.50, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE       =   2472.56 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X=  9.00  Y= 72.50, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE       =     67.34 (LBS/SQ.FT)


 FOR LOAD CASE  4,

 FOR THE BASE COORDINATES  X= -2.00  Y= 72.50, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE       =   2652.98 (LBS/SQ.FT)

 FOR THE BASE COORDINATES  X=  9.00  Y= 72.50, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE       =    176.58 (LBS/SQ.FT)
```

ANALYSIS OF COMPLEX RETAINING WALL
11:18:17 ON 10/ 1/80

*
* BEGIN COST ANALYSIS
*

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	0.	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	0.	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	16.63	1.00	16.63
BASE	18.75	1.00	18.75
KEY	0.	1.00	0.

TOTAL CONCRETE VOLUME = 35.38 (CU FT / LF), FOR LOAD CASE 3

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	106.49	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	21.77	0.	0.
6	0.	0.	0.

```
                 COST & VOLUME OF CONCRETE
-----------------------------------------------------------------
SECTION            VOLUME           UNIT COST           TOTAL COST
               (CU.FT/L.FT)    (DOLLARS/CU.FT)      (DOLLARS/L.FT)
  STEM             16.63             1.00                 16.63
  BASE             18.75             1.00                 18.75
  KEY               0.               1.00                  0.

TOTAL CONCRETE VOLUME =          35.38 (CU FT / LF), FOR LOAD CASE  4
B4,DKEY,BS,HTE1,DCOST =    11.000 ,******** ,    0.     ,  72.500 ,     35.38


#
# BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE  3
#

> CRMIN        FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF   72.50 IS       3.1898


#
# BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE  4
#

> CRMIN        FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF   72.50 IS       3.1898

ENTERING S/R  LOADARRAY
> FUNCT. YSH =   87.29000     FROM X =  0.
> FUNCT. YSH =   87.45667     FROM X =   1.000000
> FUNCT. YSH =   87.62333     FROM X =   2.000000
> FUNCT. YSH =   87.79000     FROM X =   3.000000
> FUNCT. YSH =   87.95667     FROM X =   4.000000
> FUNCT. YSH =   88.12333     FROM X =   5.000000
> FUNCT. YSH =   88.29000     FROM X =   6.000000
> FUNCT. YSH =   88.45667     FROM X =   7.000000
> FUNCT. YSH =   88.62333     FROM X =   8.000000
> FUNCT. YSH =   88.79000     FROM X =   9.000000
> FUNCT. YSH =   88.95667     FROM X =   10.00000
> FUNCT. YSH =   89.12333     FROM X =   11.00000
> ENTER S/R PRSDAT
> ENTER S/R PRSDAT
> FUNCT. YSH =   87.29000     FROM X =  0.
> FUNCT. YSH =   87.45667     FROM X =   1.000000
> FUNCT. YSH =   87.62333     FROM X =   2.000000
> FUNCT. YSH =   87.79000     FROM X =   3.000000
> FUNCT. YSH =   87.95667     FROM X =   4.000000
> FUNCT. YSH =   88.12333     FROM X =   5.000000
> FUNCT. YSH =   88.29000     FROM X =   6.000000
> FUNCT. YSH =   88.45667     FROM X =   7.000000
> FUNCT. YSH =   88.62333     FROM X =   8.000000
> FUNCT. YSH =   88.79000     FROM X =   9.000000
> FUNCT. YSH =   88.95667     FROM X =   10.00000
> FUNCT. YSH =   89.12333     FROM X =   11.00000
> ENTER S/R PRSDAT
> ENTER S/R PRSDAT
ARRAYS ARE ALL BUILT FOR THE STRUCTURAL MODULES
```

```
ANALYSIS OF COMPLEX RETAINING WALL
        11:18:19 ON 10/ 1/80


*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*

> VALUE OF HS1H(LC)   FOUND =    0.            IN S/R CHEKRT (LOAD CASE  3)

> HS1(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> VALUE OF WDS2(LC)   FOUND =    0.            IN S/R CHEKRT (LOAD CASE  3)

> HS2(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> VALUE OF HS3(LC)    FOUND =    6.000000      IN S/R CHEKRT (LOAD CASE  3)

NSURL AT BEGINNING OF S/R SURFACE= 1
B1= 87.29  S1=  0.17  B2=113.50  S2=-26.00

> VALUE OF FSS        FOUND =    1.000000      IN S/R CHEKRT (LOAD CASE  3)

> VALUE OF FXW        FOUND =    2.000000      IN S/R CHEKRT (LOAD CASE  3)

> VALUE OF HSSSH      FOUND =    6.000000      IN S/R CHEKRT (LOAD CASE  3)

> VALUE OF DTSSH      FOUND =    0.            IN S/R CHEKRT (LOAD CASE  3)
B2= 61.50  S2=  1.00  B1N= 87.29  S1N=  0.17
BF= 70.09  SF=  0.27  B1N= 87.29  S1N=  0.17
      1   1.00  87.46
      2  30.95  92.45
      3 169.85 115.60
NSURL AT END OF S/R SURFACE = 2
SURFACE 1  GAMA=120.00  COH=  0.    PHI= 30.00
SURFACE 2  GAMA=120.00  COH=  0.    PHI= 18.00

> GAMAS2(LC) FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> VALUE OF GAMAS1(LC) FOUND =   120.0000      IN S/R CHEKRT (LOAD CASE  3)

> VALUE OF COH1(LC)   FOUND =   0.            IN S/R CHEKRT (LOAD CASE  3)

> VALUE OF PHI1(LC)   FOUND =   30.00000      IN S/R CHEKRT (LOAD CASE  3)

> VALUE OF DELTA1(LC) FOUND =   0.            IN S/R CHEKRT (LOAD CASE  3)

> GAMASF(LC) FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKAFZ(LC)  FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKA2(LC)   FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKA1(LC)   FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKAEFZ(LC) FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKAE2(LC)  FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> RKAE1(LC)  FOUND UNDEFINED, LEFT AS IS (LOAD CASE  3)

> VALUE OF RKH(LC)    FOUND =   0.            IN S/R CHEKRT (LOAD CASE  3)

> VALUE OF ELWH(LC)   FOUND =   84.50000      IN S/R CHEKRT (LOAD CASE  3)
```

```
THE VERTICAL INCREMENT =  1.00 FT.  NO.OF WALL POINTS =  2

WALL PT.   X        Y
    1       1.00  87.46
    2       1.50  74.50

NUMBER OF SOIL LAYERS =1
SOIL NO.  GAMMA     COH     PHI    DELTA
   1       120.00    0.     30.00   0.
SOIL NO 1  KA ********  KAE =  0.
WATER EL. = 84.50  ACCEL =  0.     BETA =  9.46
ELEV AT BOTTOM OF SOIL 1  = 72.50
LINE LOAD 1  MAG =  0.     DIST =  0.
MAG OF UNIF LOAD =  0.     DIST TO LEFT END =  0.     DIST TO RIGHT END =  0.

        ENTERING S/R CLASSIC FROM MODULE SA-SP

   INPUT DATA FOR SUBROUTINE CLASSIC

   BACKFILL DESCRIPTION

   EQUIV. SURFACE SLOPE         =      9.46
   ELEVATION OF WATER SURFACE  =     84.50
   INCREMENT LENGTH             =      1.00

   BACKFILL SOIL DESCRIPTION

       FROM       TO         UNIT WT          PHI           C           KA
       (FT)      (FT)         (PCF)          (DEG)        (PSF)
     SURFACE    72.50        120.00          30.00         0.         ********

   WALL BREAK POINTS

   POINT       X-COORD    Y-COORD
     NO         (FT)       (FT)
      1          1.00      87.46
      2          1.50      74.50

   DATA FROM SUBROUTINE CLASSIC

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
   BACKFILL LAYER           KA VALUE
   --------------           --------
          1                  0.3886
          2                  0.3886

   COORDINATES AND STATIC ACTIVE SOIL PRESSURES
   FOR EACH SOIL LAYER

      COORDINATES          ACTIVE            ACTIVE
      AT WALL (FT)        PRESSURE           COEFF.
       X        Y          (PSF)
      1.00    87.46          0.          0.3886
      1.12    84.50        137.88        0.3886
      1.12    84.50        137.88        0.3886
      1.50    74.50        361.31        0.3886
```

STATIC ACTIVE SOIL FORCES

Y-COORD (FT)	SOIL FORCE (LB/FT) HORIZONTAL	VERTICAL
87.46	7.78	0.
86.46	46.70	0.
85.46	93.36	0.
84.46	135.45	0.
83.46	161.42	0.
82.46	183.80	0.
81.46	206.18	0.
80.46	228.55	0.
79.46	250.93	0.
78.46	273.30	0.
77.46	295.68	0.
76.46	318.06	0.
75.46	332.67	0.
74.50	169.59	0.

OUTPUT FROM SUBROUTINE CLASSIC

POINT NO	Y-COORD (FT)	STATIC FORCES (LB/FT) HORIZ	VERT	EARTHQUAKE FORCES (LB/FT) HORIZ	VERT
1	87.46	7.78	0.	0.	0.
2	86.46	46.70	0.	0.	0.
3	85.46	93.36	0.	0.	0.
4	84.46	135.45	0.	0.	0.
5	83.46	161.42	0.	0.	0.
6	82.46	183.80	0.	0.	0.
7	81.46	206.18	0.	0.	0.
8	80.46	228.55	0.	0.	0.
9	79.46	250.93	0.	0.	0.
10	78.46	273.30	0.	0.	0.
11	77.46	295.68	0.	0.	0.
12	76.46	318.06	0.	0.	0.
13	75.46	332.67	0.	0.	0.
14	74.50	169.59	0.	0.	0.

RESULTANTS OF STATIC SOIL AND SURCHARGE FORCES

HORIZONTAL = 2703.46 (LB/FT) AT Y = 79.26 (FT)
VERTICAL = 0. (LB/FT)

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 5
FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
87.457	7.7830	0.
86.457	46.698	0.
85.457	93.355	0.
84.457	135.45	0.
83.457	161.42	0.
82.457	183.80	0.
81.457	206.18	0.
80.457	228.55	0.
79.457	250.93	0.
78.457	273.30	0.
77.457	295.68	0.
76.457	318.06	0.
75.457	332.67	0.
74.500	169.59	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 2703.46 LBS/HORIZ FT
ACTING AT ELEVATION 79.26

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

```
ANALYSIS OF COMPLEX RETAINING WALL
        11:18:21 ON 10/ 1/80


#
# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#

> VALUE OF DS1H(LC)    FOUND =    0.              IN S/R CHEKRT (LOAD CASE  4)

> HS1(LC)     FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> VALUE OF WDS2(LC)    FOUND =    0.              IN S/R CHEKRT (LOAD CASE  4)

> HS2(LC)     FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> VALUE OF HS3(LC)     FOUND =    6.000000        IN S/R CHEKRT (LOAD CASE  4)

NSURL AT BEGINNING OF S/R SURFACE= 1
B1= 87.29  S1=  0.17  B2=113.50  S2=-26.00

> VALUE OF FSS         FOUND =    1.000000        IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF FXW         FOUND =    2.000000        IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF HSSSH       FOUND =    6.000000        IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF DTSSH       FOUND =    0.              IN S/R CHEKRT (LOAD CASE  4)
B2= 61.50  S2=  1.00  BIN= 87.29  SIN=  0.17
HF= 70.09  SF=  0.27  HIN= 87.29  SIN=  0.17
      1   1.00  87.46
      2  30.95  92.45
      3 169.85 115.60
NSURL AT END OF S/R SURFACE = 2
SURFACE 1  GAMA=120.00  COH=  0.    PHI= 30.00
SURFACE 2  GAMA=120.00  COH=  0.    PHI= 18.00
> GAMAS2(LC) FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> VALUE OF GAMAS1(LC) FOUND =    120.0000         IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF COH1(LC)    FOUND =    0.              IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF PHI1(LC)    FOUND =    30.00000        IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF DELTA1(LC) FOUND =    0.               IN S/R CHEKRT (LOAD CASE  4)

> GAMASF(LC) FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKAFZ(LC)  FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKA2(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKA1(LC)    FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKAFFZ(LC) FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKAE2(LC)  FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> RKAE1(LC)  FOUND UNDEFINED, LEFT AS IS (LOAD CASE  4)

> VALUE OF RKH(LC)     FOUND =    0.              IN S/R CHEKRT (LOAD CASE  4)

> VALUE OF FLWH(LC)    FOUND =    84.50000        IN S/R CHEKRT (LOAD CASE  4)
```

```
THE VERTICAL INCREMENT =  1.00 FT.  NO.OF WALL POINTS =  2

WALL PT.   X       Y
    1      1.00  87.46
    2      1.50  74.50

NUMBER OF SOIL LAYERS =1
SOIL NO.  GAMMA     COH     PHI    DELTA
   1      120.00    0.     30.00    0.
SOIL NO 1  KA *******  KAE =  0.
WATER EL. = 84.50  ACCEL =  0.     BETA =  9.46
ELEV AT BOTTOM OF SOIL 1  = 72.50
LINE LOAD 1  MAG =400.00  DIST =  2.00
LINE LOAD 2  MAG =800.00  DIST =  4.00
LINE LOAD 3  MAG =400.00  DIST =  7.00
MAG OF UNIF LOAD =  0.     DIST TO LEFT END =  0.     DIST TO RIGHT END =  0.


      ENTERING S/R CLASSIC FROM MODULE SA-SP


   INPUT DATA FOR SUBROUTINE CLASSIC

   BACKFILL DESCRIPTION

   EQUIV. SURFACE SLOPE        =      9.46
   ELEVATION OF WATER SURFACE =     84.50
   INCREMENT LENGTH            =      1.00


   BACKFILL SOIL DESCRIPTION

       FROM      TO        UNIT WT          PHI          C          KA
       (FT)     (FT)        (PCF)          (DEG)       (PSF)
    SURFACE    72.50       120.00          30.00        0.      ********

   WALL BREAK POINTS

   POINT       X-COORD   Y-COORD
     NO          (FT)      (FT)
      1          1.00     87.46
      2          1.50     74.50

   SURCHARGE LINE LOADS

    LOAD      DISTANCE      LINE LOAD
     NO         (FT)          (PLF)
      1         2.00         400.00
     0.00           4.00
   800.00           0.00
     7.00         400.00


   DATA FROM SUBROUTINE CLASSIC


 COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
   BACKFILL LAYER           KA VALUE
   ..............           ........
          1                  0.3886
          2                  0.3886
```

COORDINATES AND STATIC ACTIVE SOIL PRESSURES
FOR EACH SOIL LAYER

COORDINATES AT WALL (FT) X	Y	ACTIVE PRESSURE (PSF)	ACTIVE COEFF.
1.00	87.46	0.	0.3886
1.12	84.50	137.88	0.3886
1.12	84.50	137.88	0.3886
1.50	74.50	361.31	0.3886

STATIC ACTIVE SOIL FORCES

Y-COORD (FT)	SOIL FORCE (LB/FT) HORIZONTAL	VERTICAL
87.46	7.78	0.
86.46	46.70	0.
85.46	93.36	0.
84.46	135.45	0.
83.46	161.42	0.
82.46	183.80	0.
81.46	206.18	0.
80.46	228.55	0.
79.46	250.93	0.
78.46	273.30	0.
77.46	295.68	0.
76.46	318.06	0.
75.46	332.67	0.
74.50	169.59	0.

WALL FORCES DUE TO LINE LOADS

PRESSURES AND FORCES DUE TO LOAD NO. 1

Y-COORD (FT)	PRESSURE (PSF)	FORCE (LB/FT)
87.46	0.	2.93
86.46	17.56	16.48
85.46	28.63	27.31
84.46	31.80	30.92
83.46	29.68	29.31
82.46	25.34	25.29
81.46	20.70	20.79
80.46	16.58	16.71
79.46	13.21	13.33
78.46	10.55	10.64
77.46	8.47	8.55
76.46	6.86	6.92
75.46	5.60	5.54
74.50	4.66	2.38

PRESSURES AND FORCES DUE TO LOAD NO. 2

Y-COORD (FT)	PRESSURE (PSF)	FORCE (LB/FT)
87.46	0.	5.85
86.46	35.12	32.96
85.46	57.25	54.62
84.46	63.60	61.84
83.46	59.36	58.62
82.46	50.68	50.58
81.46	41.40	41.57
80.46	33.16	33.41
79.46	26.42	26.66
78.46	21.09	21.29
77.46	16.94	17.10
76.46	13.72	13.84
75.46	11.21	11.08
74.50	9.31	4.76

PRESSURES AND FORCES DUE TO LOAD NO. 3

Y-COORD (FT)	PRESSURE (PSF)	FORCE (LB/FT)
87.46	0.	1.66
86.46	9.98	9.62
85.46	17.77	17.22
84.46	22.26	21.74
83.46	23.63	23.26
82.46	22.79	22.58
81.46	20.72	20.65
80.46	18.19	18.19
79.46	15.64	15.67
78.46	13.29	13.34
77.46	11.24	11.29
76.46	9.50	9.55
75.46	8.04	7.92
74.50	6.87	3.47

OUTPUT FROM SUBROUTINE CLASSIC

POINT NO	Y-COORD (FT)	STATIC FORCES (LB/FT) HORIZ	VERT	EARTHQUAKE FORCES (LB/FT) HORIZ	VERT
1	87.46	18.23	0.	0.	0.
2	86.46	105.75	0.	0.	0.
3	85.46	192.51	0.	0.	0.
4	84.46	249.94	0.	0.	0.
5	83.46	272.62	0.	0.	0.
6	82.46	282.26	0.	0.	0.
7	81.46	289.18	0.	0.	0.
8	80.46	296.85	0.	0.	0.
9	79.46	306.58	0.	0.	0.
10	78.46	318.57	0.	0.	0.
11	77.46	332.61	0.	0.	0.
12	76.46	348.36	0.	0.	0.
13	75.46	357.21	0.	0.	0.
14	74.50	180.20	0.	0.	0.

RESULTANTS OF STATIC SOIL AND SURCHARGE FORCES

HORIZONTAL = 3550.87 (LB/FT) AT Y = 79.95 (FT)
VERTICAL = 0. (LB/FT)

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 4
FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
87.457	18.227	0.
86.457	105.75	0.
85.457	192.51	0.
84.457	249.94	0.
83.457	272.62	0.
82.457	282.26	0.
81.457	289.18	0.
80.457	296.85	0.
79.457	306.58	0.
78.457	318.57	0.
77.457	332.61	0.
76.457	348.36	0.
75.457	357.21	0.
74.500	180.20	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 3550.87 LBS/HORIZ FT
ACTING AT ELEVATION 79.95

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

*
* EXIT MODULE FA
*

```
ANALYSIS OF COMPLEX RETAINING WALL
        11:18:42 ON 10/ 1/80


#
# BEGIN PLOTTING DATA PREPARATION
#

NOTE THAT DEFAULT VALUES WILL BE SET PERMANENTLY INTO GEOMETRY DATA.


                  COORDINATES OF CORNERS OF WALL CROSS-SECTION

           X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
           Y-COORDINATES ARE ELEVATIONS

      PT.      X           Y                     DESCRIPTION OF POINT
      --   --------   ----------    ----------------------------------------------
       1     0.          87.5000    BASIC WORKING POINT = TOE-SIDE OF STEM TOP
       2     0.          74.0000    BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
       3     0.          74.0000    BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
       4    -2.0000      74.0000    TOP OF TOEHT = AT OUTER END OF TW2
       5    -2.0000      72.5000    TOE END OF BASE = AT BTE1
       6     9.0000      72.5000    TOP OF TOE-SIDE FACE OF KEY
       7     9.0000      72.5000    BOTTOM OF TOE-SIDE FACE OF KEY
       8     9.0000      72.5000    BOTTOM OF HEEL-SIDE FACE OF KEY
       9     9.0000      72.5000    TOP OF HEEL-SIDE FACE OF KEY
      10     9.0000      72.5000    HEEL END OF BASE
      11     9.0000      74.0000    TOP OF HEELT2 = TOP OF OUTER END OF HEEL
      12     1.5000      74.5000    BOTTOM OF HEEL-SIDE FACE OF STEM
      13     1.0000      87.5000    BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
      14     1.0000      87.5000    TOP OF HEEL-SIDE FACE OF STEM
      15     8.5000      72.5000    BOTTOM OF CUTOFF WALL UNDER KEY

WALL DATA LISTS:

WLA      FTS            TW2              STR            HEELW
     87.50000        2.000000      -0.1234000E 31 -0.1234000E 31

WLAB     BW              BS                              BASER (LIST=WLBR)
     11.00000       0.                                -0.1234000E 31

WLAH   HEELT2          HEELW          HEELT1
     18.00000      -0.1234000E 31   24.00000

WLAK   KFLAG            DKEY           WKEY             BKTF
   -100000         -0.1234000E 31 -0.1234000E 31 -0.1234000E 31

WLAS    TSTT            TSB            TSTB             HBTPH              HSTPB
     12.00000       0.                 18.00000       0.                0.
      HSBPB
    0.4615385

WLAT    HTE1           TOEHT           TS2              TW1                TS1
     72.50000       18.00000       100.0000        0.              100.0000

----  TMINH            TMINS
   -0.1234000E 31 -0.1234000E 31
```

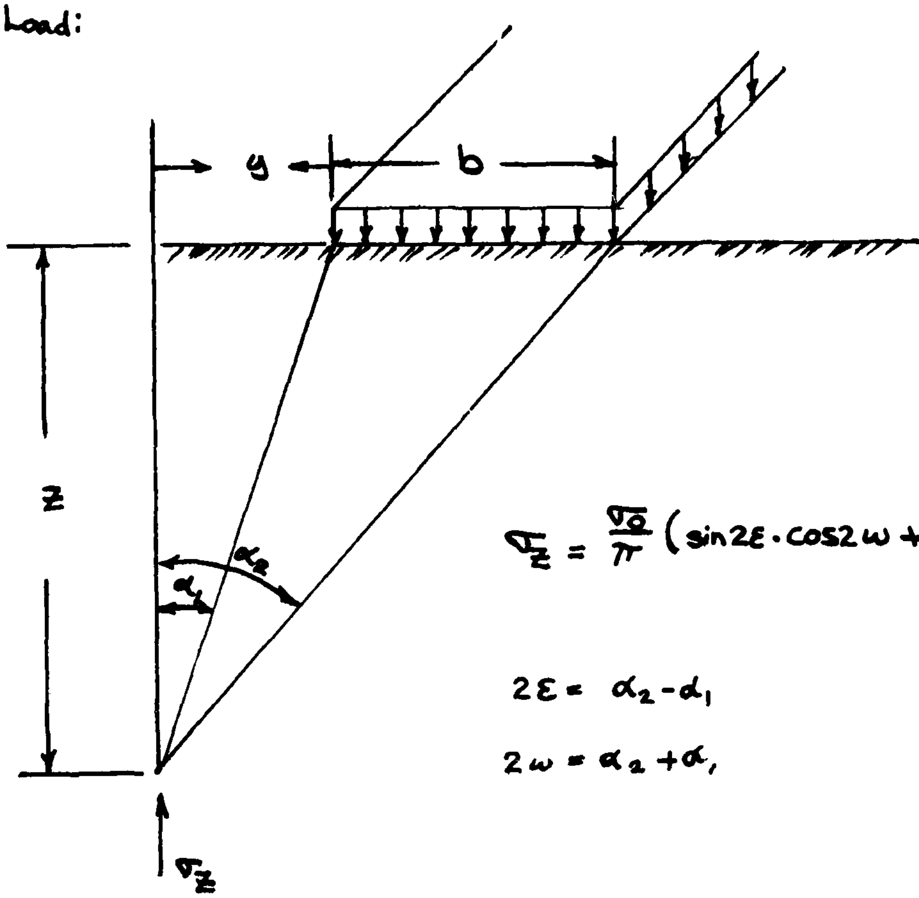
```
---------- PRESSURE DATA VERIFICATION FOR LOAD CASE   3 ----------

FH TOP CALCULATED TO BE      84.500
FOR LOAD CASE  3

> AT FH      IN PREWUA
> ENTER S/R PRSDAT

> AT EFH     IN PREWUA
> ENTER S/R PRSDAT

> FHTOP  IS       84.500

> TABLE OF HORIZONTAL NET HYDRO PRESSURES FOR LC =  3
   I    ELEV.     FH(LC,I)    EFH(LC,I)
    1  84.50  0.              0.
    2  83.50   49.06          0.
    3  82.50   98.13          0.
    4  81.50   147.2          0.
    5  80.50   196.3          0.
    6  79.50   245.3          0.
    7  78.50   294.4          0.
    8  77.50   146.6          0.
    9  76.50   117.3          0.
   10  75.50   87.98          0.
   11  74.50   58.66          0.
   12  73.50   29.33          0.
   13  72.50  0.              0.
   14  71.50   147.1          0.
> AT FV      IN PREWUA
> ENTER S/R PRSDAT

> TABLE OF VERTICAL UPLIFT PRESSURES FOR LC =  3
   I    DIST.    X-COORD.       FV(LC,I)
    1    0.     -2.000         -147.8
    2    1.00   -1.000         -187.9
    3    2.00   0.             -228.0
    4    3.00    1.000         -268.1
    5    4.00    2.000         -308.2
    6    5.00    3.000         -348.2
    7    6.00    4.000         -388.3
    8    7.00    5.000         -428.4
    9    8.00    6.000         -468.5
   10    9.00    7.000         -508.6
   11   10.00    8.000         -548.7
   12   11.00    9.000         -588.8
   13   12.00    10.00         -628.8

> AT V       IN PREWUA
> ENTER S/R PRSDAT

> TABLE OF VERTICAL EARTH WEIGHT + SURCHARGE PRESSURES FOR LC =  3
   I    DIST.    X-COORD.        V(LC,I)
  OVER TOE :
    1    0.     -2.000          172.5
    2    1.00   -1.000          172.5
    3    2.00   0.              172.5
  OVER HEEL:
    4    2.00   0.              172.5
    5    3.00    1.000          904.0
    6    4.00    2.000          927.9
    7    5.00    3.000          951.7
    8    6.00    4.000          975.6
    9    7.00    5.000          999.4
   10    8.00    6.000          1023.
   11    9.00    7.000          1047.
   12   10.00    8.000          1071.
   13   11.00    9.000          1095.
   14   12.00    10.00          1119.
```

```
> AT EV      IN PREWUA
> ENTER S/R PRSDAT

  ---------- PRESSURE DATA VERIFICATION FOR LOAD CASE   4 ----------

FH TOP CALCULATED TO BE      84.500
FOR LOAD CASE  4

> AT FH      IN PREWUA
> ENTER S/R PRSDAT

> AT EFH     IN PREWUA
> ENTER S/R PRSDAT

> FHTOP  IS       84.500

> TABLE OF HORIZONTAL NET HYDRO PRESSURES FOR LC =  4
    I   ELEV.     FH(LC,I)    EFH(LC,I)
    1  84.50  0.             0.
    2  83.50   49.06         0.
    3  82.50   98.13         0.
    4  81.50   147.2         0.
    5  80.50   196.3         0.
    6  79.50   245.3         0.
    7  78.50   294.4         0.
    8  77.50   146.6         0.
    9  76.50   117.3         0.
   10  75.50   87.98         0.
   11  74.50   58.66         0.
   12  73.50   29.33         0.
   13  72.50  0.             0.
   14  71.50   147.1         0.

> AT FV      IN PREWUA
> ENTER S/R PRSDAT

> TABLE OF VERTICAL UPLIFT PRESSURES FOR LC =  4
    I   DIST.   X-COORD.     FV(LC,I)
    1   0.      -2.000       -147.8
    2   1.00    -1.000       -187.9
    3   2.00    0.           -228.0
    4   3.00     1.000       -268.1
    5   4.00     2.000       -308.2
    6   5.00     3.000       -348.2
    7   6.00     4.000       -388.3
    8   7.00     5.000       -428.4
    9   8.00     6.000       -468.5
   10   9.00     7.000       -508.6
   11  10.00     8.000       -548.7
   12  11.00     9.000       -588.8
   13  12.00    10.00        -628.8
```

```
> AT V        IN PREWUA
> ENTER S/R PRSDAT

> TABLE OF VERTICAL EARTH WEIGHT + SURCHARGE PRESSURES FOR LC =  4
   I    DIST.    X-COORD.       V(LC,I)
  OVER TOE ;
    1    0.     -2.000        502.4
    2    1.00   -1.000        461.6
    3    2.00   0.            339.7
  OVER HEEL;
    4    2.00   0.            234.9
    5    3.00    1.000        970.7
    6    4.00    2.000        997.7
    7    5.00    3.000        1023.
    8    6.00    4.000        1048.
    9    7.00    5.000        1071.
   10    8.00    6.000        1092.
   11    9.00    7.000        1113.
   12   10.00    8.000        1133.
   13   11.00    9.000        1152.
   14   12.00   10.00         1119.

> AT EV       IN PREWUA
> ENTER S/R PRSDAT

  --------------- END OF PRESSURE DATA VERIFICATION ----------------
> FUNCT, YSH =   87.62333     FROM X =   2.000000
> FUNCT, YSH =   87.95667     FROM X =   4.000000
> FUNCT, YSH =   88.45667     FROM X =   7.000000

#
# UPDATE FILE RESET
#

COMMAND ENTERED:
END
```

4-5 HAND CALCULATIONS. These hand calculations are based on an example of A. R. Jumkin's presented on page 100 of Soil Mechanics, 1964:

Long Strip Area Loaded with a Uniformly Distributed Load:



$$\sigma_z = \frac{\sigma_0}{\pi}\left(\sin 2\varepsilon \cdot \cos 2\omega + 2\varepsilon\right)$$

$$2\varepsilon = \alpha_2 - \alpha_1$$

$$2\omega = \alpha_2 + \alpha_1$$

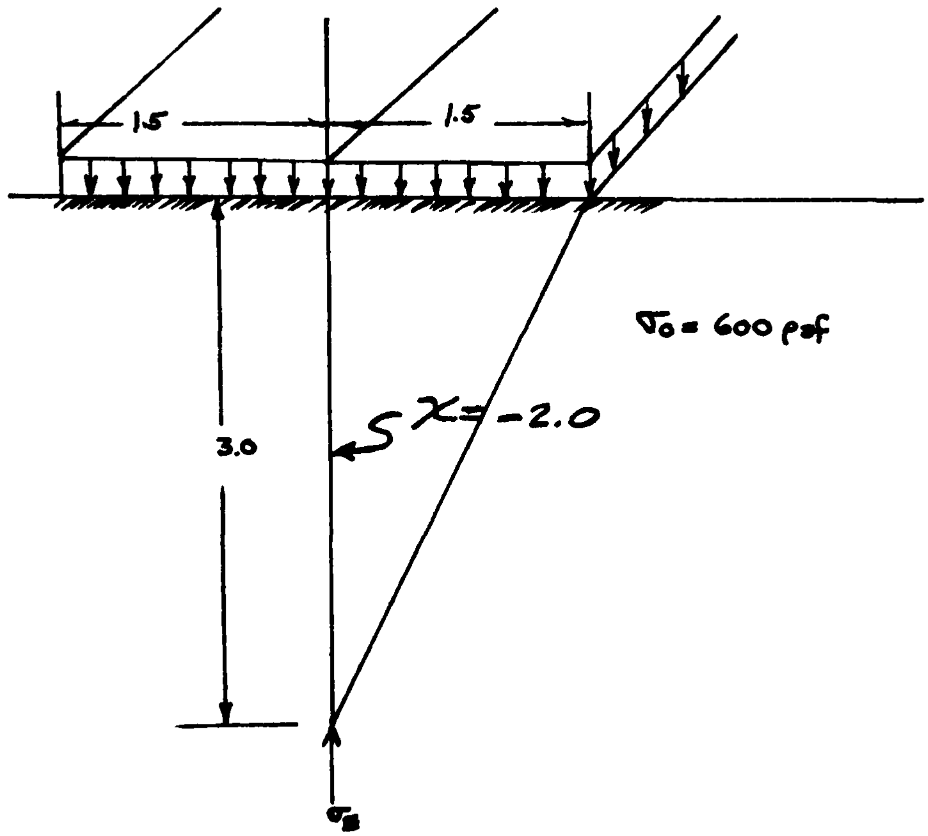
$$\alpha_2 = \tan^{-1}\left(\frac{y+b}{z}\right)$$

$$\alpha_1 = \tan^{-1}\left(\frac{y}{z}\right)$$

$$\sigma_z = \frac{\sigma_0}{\pi}\left\{\sin\left[\tan^{-1}\left(\frac{y+b}{z}\right) - \tan^{-1}\left(\frac{y}{z}\right)\right]\right.$$

$$\cos\left[\tan^{-1}\left(\frac{y+b}{z}\right)+\tan^{-1}\left(\frac{y}{z}\right)\right]+\tan^{-1}\left(\frac{y+b}{z}\right)$$

$$\left.\tan^{-1}\left(\frac{y}{z}\right)\right\}$$



due to symmeter

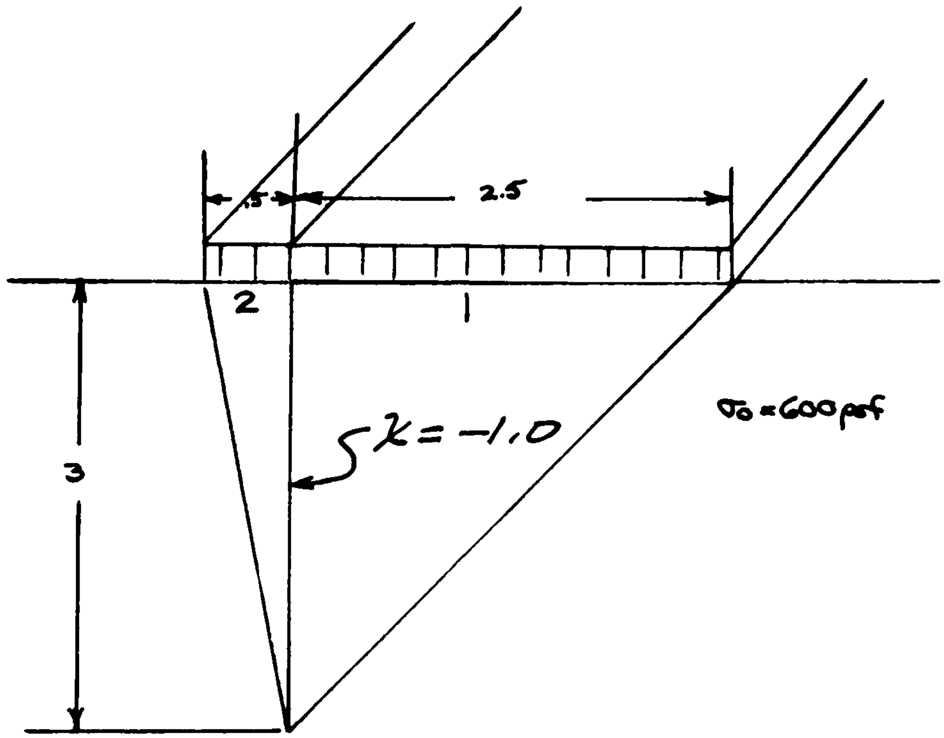
$$\frac{\sigma_z}{2} = \frac{\sigma_0}{\pi}\left(\sin 2\varepsilon \cdot \cos 2\omega + 2\varepsilon \right)$$

$$\alpha_1 = 0 \qquad \alpha_2 = \tan^{-1}\frac{1.5}{3}$$

$$\frac{\sigma_z}{2} = \frac{\sigma_0}{\pi}\left\{ \sin\left[\tan^{-1}\left(\frac{1.5}{3}\right)\right] \cos\left[\tan^{-1}\left(\frac{1.5}{3}\right)\right] + \tan^{-1}\left(\frac{1.5}{3}\right)\right\}$$

$$= 164.94 \text{ psf}$$

$$\sigma_z = 329.88 \text{ psf}$$



$$\sigma_{z1} = \frac{600\,psf}{\pi}\left[\sin\left(\tan^{-1}\frac{2.5}{3}\right)\cos\left(\tan^{-1}\frac{2.5}{3}\right) + \tan^{-1}\frac{2.5}{3}\right]$$

$$= 226.61 \text{ psf}$$

$$\sigma_{z2} = \frac{600\,psf}{\pi}\left[\sin\left(\tan^{-1}\frac{.5}{3}\right)\cos\left(\tan^{-1}\frac{.5}{3}\right) + \tan^{-1}\frac{.5}{3}\right]$$

$$= 62.51 \text{ psf}$$

$$\sigma_z = \sigma_{z1} + \sigma_{z2} = 226.61 \text{ psf} + 62.51 \text{ psf}$$

$$= 289.12 \text{ psf}$$

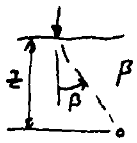
Vertical pressure from line surcharge PV2 = 800 #/ft
On heel at $x = 2$, $y = 74.4667$.

Surcharge is on backfill surface at $x = 4.00$

$\Delta x = 2.00 \quad y = 13.5'$ $\qquad y = 87.29 + \frac{4}{6} = 87.9667$

Reference "Theoretical Soil Mechanics" by Jumikis
Equation 8-9 on p. 112:

$$\sigma_z = \frac{2p}{\pi z} \cos^4 \beta$$



$$\beta = \tan^{-1} \frac{\Delta x}{\Delta y} = \tan^{-1} \frac{2}{13.5} = 8.427°$$

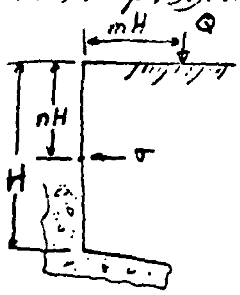
$$= \frac{2(800)}{\pi(13.5)}(.95751)$$

$\cos\beta = 0.9892$

$$= 36.123 \text{ psf}$$

$\cos^4\beta = 0.95751$

Horizontal pressure from line load PV2 = 800 #/ft
$x = 4.00$, $y = 87.9667$
on stem at $y = 80.46'$, $x = 1.2$ from Module SP
Reference page A-10 of Exhibit A to the program criteria specifications document.



$$H = 87.9667 - y(12) = 13.4667'$$

$$n = \frac{87.9667 - 80.46}{13.4667} = 0.5574$$

$$m = \frac{4.00 - 1.2}{13.4667} = 0.2079$$

$$\sigma = \frac{Q}{H} \frac{0.203\, n}{(0.16 + n^2)^2}$$

$$= \frac{800}{13.4667} \frac{0.203(0.5574)}{(0.16 + 0.5574^2)^2} = 30.34 \text{ psf}$$

4-6 COMPARISONS OF RESULTS

4-6-1 Distributed Surcharge Over Toe (Load Case 4):

Item	Program	Hand Calculation	Difference	Percent of Hand
Vertical pressures on toe				
At X = -2.0	329.89	329.88	0.01	0
At X = -1.0	289.125	289.12	0	0
At X = 0.0	292.219			

4-6-2 Concentrated Line Load Surcharges Over Heel:

a. Vertical pressure at X = 2.00, Y = 74.4667, from line surcharge of 800 lb/ft at X = 4, Y = 87.96:

Program	Hand Calculation	Difference	Percent of Hand
36.15 psf	36.12 psf	0.03	0.08

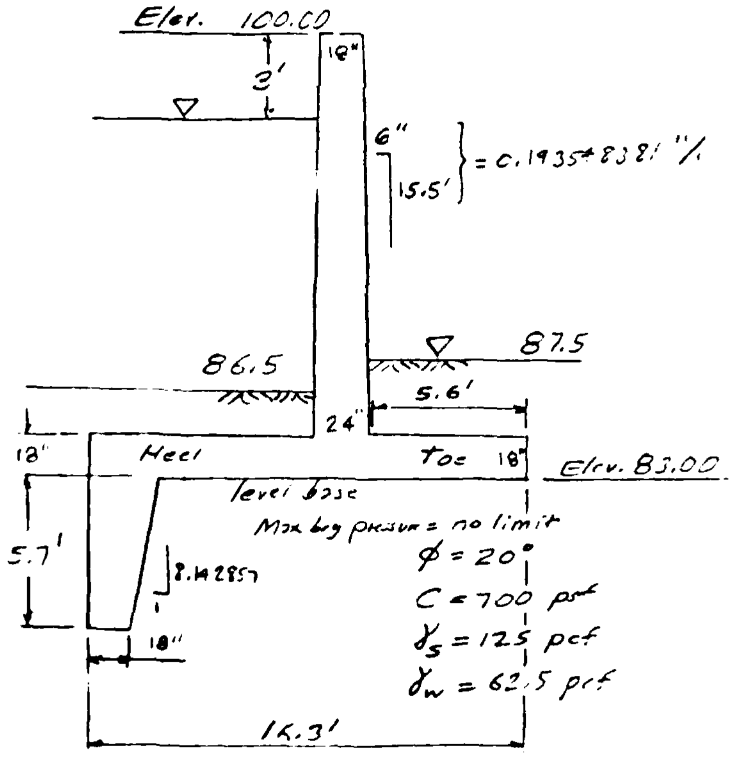
b. Horizontal pressure on stem at el 80.46, from module SP:

Program	Hand Calculation	Difference	Percent of Hand
33.16 psf	30.34 psf	2.82	9.3

CHAPTER 5: PROBLEM V4

5-1 DESCRIPTION OF PROBLEM. This problem is the same as example C in the User's Reference Manual; i.e., a stability analysis and structural design of the hybrid wall presented in Exhibit H of the Program Criteria Specifications Document. The wall is essentially a floodwall with a slight difference in finished backfill grades. The soil system has a single homogeneous silt layer in the drained, unconsolidated condition:

Take the wall shown in the sliding exhibits to the Criteria Specifications Document and perform a stability analysis on the wall, then do a structural design for the pressures resulting from the stability analysis. Set up 3 load cases, #1 by flood wall rules; #2 by retaining wall; and #3 by the hybrid (trapezoidal passive pressure diagram, no crack in the heel corr.), to show the differences. Use IFOR and IFLIM = 0 to get the structural design exactly for the loads specified.



5-1-1 Load case 1 is analyzed using floodwall default values:

a. Crack in earth cover over heel.

b. Trapezoidal shape for diagram of overturning passive earth pressure.

c. Allowable strength equilibrium method for sliding; C' = C/(FS + 2C').

5-1-2 Load case 2 is analyzed using retaining wall default values:

a. No crack in earth cover; use active earth.

b. Triangular shap for diagram of overturning passive earth pressure.

c. Shear friction method for sliding.

5-1-3 Load case 3 is analyzed using a hybrid set of values:

a. Active earth pressure; no crack in earth over heel.

b. Trapezoidal shape for diagram of overturning passive earth pressure.

c. Allowable strength equilibrium method for sliding; C' = C/(FS + 2C').

5-2 DATA PREPARATION:

Soils Preparation Data:
Required Data Lists: SOL1, SOL3, SOL7
Optional Data Lists: not used

Finished Grade Data: same as example #1

Water: Line of creep, no boil control

Soils Design Parameters

	Load case	NPPD	KRACK
FW	1	D=1	D=1
RW	2	D=3	D=2
Hybrid	3	1	2

Structural: All default values ok except use IFEM = IFDR = 0
CND D D D D, CNVD D D D 1 0 (IBSAME=1)

Demonstrate Commands in the data file: RUN FA, RUN WD, END:

Note use of REM command to annote the data file. These lines will not be executed and are solely to make the data file more readable to the user.

DATA FILE:

```
1000 INIT
1010 3
1020 F
1030 H
1040 NAME EXAMPLE V4 -- FROM SLIDING EXHIBITS TO CRITERIA DOC., REF. EXC
1045 REM
1050 REM  BASIC GENERAL WALL EXAMPLE -- STABILITY ANALYSIS, STRESS DESIGN
1100 REM
1110 REM  LINE 1020 (ANSWER F) SET ALL LOAD CASES FOR FLOOD WALL ACTION,
1120 REM  USE DATA LIST TYPE TO RESET LOAD CASE 2 FOR RETAINING WALL ACTION:
1130 TYPE  2  2
1140 REM
1150 REM  LINE 1030 (ANSWER H) SET ALL LOAD CASES FOR HYDRAULIC OPTIONS;
1160 REM  THIS IS NOT CHANGEABLE.
1170 REM
2000 SPH1  0  20  700  125  C  0  C  0
2010 REM  DATA LIST SPT7 WILL BE COPIED AUTOMATICALLY FROM DATA LIST SPE3
2015 REM
2020 SSHC  0  86.5  100.0
2030 SST   0  87.5  100.0
2035 REM
2040 SPE3  20  700  125  20  700  8000  8000  8000  8000  50
2100 SOLE  2  1  100.0  87.5  0  87.0  86.5  0  100.0
2110 REM
2200 SEEP  0  87.5  97.0  0  0  1  1
2210 SEEP  2   S     C    S  S  S  2
2220 SEEP  3   S     S    S  S  S  2
2300 REM
3000 WLA  100.0  5.6  C  C
3010 WLAB 16.3  10.0  20.0  0.0
3020 WLAH  18.0  C  18.0
3030 WLAK 0  5.7  18.0  8.142857
3040 WLAS 18.0  0.193548387  24.0  0.0  0.0  C
3050 WLAT  83.0  18.0  100.0  0.0  C
3060 REM
3070 REM  NOTE USE OF REM COMMAND TO ANNOTE DATA FILE (NOT EXECUTED)
3080 REM  (THERE ARE ACTUALLY ONLY 18 LINES OF DATA FOR 3 LOAD CASES)
4000 REM
4100 UPDATE


•RESAVE EXV4DAT
DATA SAVED-EXV4DAT
```

5-3 TIME-SHARING TERMINAL INPUT/OUTPUT:

```
*FORTRAN
*RUN WESLIB/TWDA,R

        09/25/80    12.303

:

PROGRAM TWDA -- 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
       REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EXV4UPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?W.A.PRICE
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?EXV4DAT
PROCESSING DATA FILE...

#
# UPDATE FILE RESET
#

#
# DATA FILE PROCESSING DONE
#
# RETURN TO INTERACTIVE INPUT
#

COMMAND
?RUN FA


THE RESULTANT RATIO =      0.3197, FOR LOAD CASE  1


THE RESULTANT RATIO =      0.3382, FOR LOAD CASE  2


THE RESULTANT RATIO =      0.3618, FOR LOAD CASE  3
```

```
FINAL FACTOR OF SAFETY AGAINST SLIDING =      3.99, FOR LOAD CASE  1
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS


FINAL FACTOR OF SAFETY AGAINST SLIDING =      5.52, FOR LOAD CASE  2
BY SHEAR FRICTION METHOD


FINAL FACTOR OF SAFETY AGAINST SLIDING =      4.01, FOR LOAD CASE  3
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS


TOTAL CONCRETE VOLUME =          62.12 (CU FT / LF), FOR LOAD CASE  1


TOTAL CONCRETE VOLUME =          62.12 (CU FT / LF), FOR LOAD CASE  2


TOTAL CONCRETE VOLUME =          62.12 (CU FT / LF), FOR LOAD CASE  3

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
        (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD.)
   OR 0 TO OMIT THE PLOTS
?0

#
# UPDATE FILE RESET
#


#
# COMMAND-DATA PHASE ENTERED
#

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?5
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
?A3

SNUMB # 2497A


YOUR UPDATE FILE FOR FUTURE RESTART IS NAMED EXV4UPD
STOP    OK (RELEASE UNNEEDED FILES)

•
```

5-4 REPORT FILE PRINTOUT:

```
&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&&
          12:18:52 ON  9/25/80


NOTES TO EXPLAIN SPECIAL PRINTOUT THAT MIGHT BE IN THIS FILE--

THE VALUE "-.1234E+31" IS USED TO DENOTE AN  UNDEFINED ITEM;
THE VALUE "-.1432E+31" MEANS THAT THE DEFAULT VALUE WAS REQUESTED.

A "MEMORY FAULT AT ..." MESSAGE PROBABLY MEANS THAT NEEDED DATA IS UNDEFINED.

.                                                                           .

END OF NOTES.

COMMAND ENTERED:
INIT

*- ALL DATA RESET FOR FRESH START -*

COMMAND ENTERED:
F

COMMAND ENTERED:
H
```

```
12:19:18 ON 07/25/80

WALL DECLARED TO BE A HYDRAULIC FLOOD WALL

COMMAND ENTERED:
NAME EXAMPLE VA -- FROM SLIDING EXHIBITS TO CRITERIA DOC., REF. EXC

COMMAND ENTERED:
REM

COMMAND ENTERED:
REM  BASIC GENERAL WALL EXAMPLE -- STABILITY ANALYSIS, STRESS DESIGN

COMMAND ENTERED:
REM

COMMAND ENTERED:
REM  LINE 1020 (ANSWER F) SET ALL LOAD CASES FOR FLOOD WALL ACTION,

COMMAND ENTERED:
REM  USE DATA LIST TYPE TO RESET LOAD CASE 2 FOR RETAINING WALL ACTION:

COMMAND ENTERED:
TYPE  2  2

COMMAND ENTERED:
REM

COMMAND ENTERED:
REM  LINE 1030 (ANSWER H) SET ALL LOAD CASES FOR HYDRAULIC OPTIONS;

COMMAND ENTERED:
REM  THIS IS NOT CHANGEABLE.

COMMAND ENTERED:
REM

COMMAND ENTERED:
SPR1  0  20  700  125  C  0  C  0

COMMAND ENTERED:
REM  DATA LIST SPT7 WILL BE COPIED AUTOMATICALLY FROM DATA LIST SPE3

COMMAND ENTERED:
REM

COMMAND ENTERED:
SSPC  0  86.5  100.0

COMMAND ENTERED:
SST  0  87.5  100.0

COMMAND ENTERED:
REM

COMMAND ENTERED:
SPE3  20  700  125  20  700  8000  8000  8000  8000  50

COMMAND ENTERED:
SOLE  2  1  100.0  87.5  0  87.0  86.5  0  100.0

COMMAND ENTERED:
REM

COMMAND ENTERED:
SEEP  0  87.5  97.0  0  0  1  1
```

```
COMMAND ENTERED:
SEEP  2   S      S       S   S   S   2

COMMAND ENTERED:
SEEP  3   S      S       S   S   S   2

COMMAND ENTERED:
REM

COMMAND ENTERED:
WLA   100.0   5.6   C   C

COMMAND ENTERED:
WLAB 16.3   10.0   20.0   0.0

COMMAND ENTERED:
WLAH   18.0   C   16.0

COMMAND ENTERED:
WLAK 0   5.7   18.0   8.142857

COMMAND ENTERED:
WLAS 18.0   0.193548387   24.0   0.0   0.0   C

COMMAND ENTERED:
WLAT   83.0   18.0   100.0   0.0   C

COMMAND ENTERED:
REM

COMMAND ENTERED:
REM  NOTE USE OF REM COMMAND TO ANNOTE DATA FILE (NOT EXECUTED)

COMMAND ENTERED:
REM  (THERE ARE ACTUALLY ONLY 18 LINES OF DATA FOR 3 LOAD CASES)

COMMAND ENTERED:
REM

COMMAND ENTERED:
UPDATE

#
# UPDATE FILE RESET
#

COMMAND ENTERED:

COMMAND ENTERED:
RUN FA
```

```
EXAMPLE V4 -- FROM SLIDING EXHIBITS TO CRITERIA DOC., REF. E
        12:22:49 ON  9/25/80

#
# BEGIN BASIC STABILITY DATA CHECK
#
DEFAULT VALUE OF    62.50000    USED FOR GAMAW       (LOAD CASE  1)
DEFAULT VALUE OF    150.0000    USED FOR GAMAC       (LOAD CASE  1)
DEFAULT VALUE OF    0.          USED FOR UCEXS3      (LOAD CASE  1)
DEFAULT VALUE OF    0.          USED FOR UCEXS4      (LOAD CASE  1)
DEFAULT VALUE OF    0.          USED FOR UCEXS5      (LOAD CASE  1)
DEFAULT VALUE OF    0.          USED FOR UCBFS1      (LOAD CASE  1)
DEFAULT VALUE OF    0.          USED FOR UCBFS2      (LOAD CASE  1)
DEFAULT VALUE OF    0.          USED FOR UCBFFZ      (LOAD CASE  1)
DEFAULT VALUE OF    0.          USED FOR UCBFS7      (LOAD CASE  1)
DEFAULT VALUE OF    0.          USED FOR UCBFS6      (LOAD CASE  1)
DEFAULT VALUE OF    1.000000    USED FOR UCWS        (LOAD CASE  1)
DEFAULT VALUE OF    1.000000    USED FOR UCWB        (LOAD CASE  1)
DEFAULT VALUE OF    1.000000    USED FOR UCWK        (LOAD CASE  1)
DEFAULT VALUE OF           2    USED FOR IFWUC       (LOAD CASE  1)
DEFAULT VALUE OF           1    USED FOR IFSUM       (LOAD CASE  1)
DEFAULT VALUE OF    1.000000    USED FOR CFMA        (LOAD CASE  1)
NO DEFAULT VALUE FOR RRMIN     SO SET TO UNDEFINED   (LOAD CASE  1)
DEFAULT VALUE OF    1.500000    USED FOR FSMIN       (LOAD CASE  1)
DEFAULT VALUE OF           2    USED FOR NSLIDE      (LOAD CASE  1)
DEFAULT VALUE OF           2    USED FOR IFWUC       (LOAD CASE  2)
DEFAULT VALUE OF           1    USED FOR IFSUM       (LOAD CASE  2)
DEFAULT VALUE OF    1.000000    USED FOR CFMA        (LOAD CASE  2)
DEFAULT VALUE OF    0.3333333   USED FOR RRMIN       (LOAD CASE  2)
DEFAULT VALUE OF    2.000000    USED FOR FSMIN       (LOAD CASE  2)
DEFAULT VALUE OF           1    USED FOR NSLIDE      (LOAD CASE  2)
DEFAULT VALUE OF           2    USED FOR IFWUC       (LOAD CASE  3)
DEFAULT VALUE OF           1    USED FOR IFSUM       (LOAD CASE  3)
DEFAULT VALUE OF    1.000000    USED FOR CFMA        (LOAD CASE  3)
NO DEFAULT VALUE FOR RRMIN     SO SET TO UNDEFINED   (LOAD CASE  3)
DEFAULT VALUE OF    1.500000    USED FOR FSMIN       (LOAD CASE  3)
DEFAULT VALUE OF           2    USED FOR NSLIDE      (LOAD CASE  3)
```

```
EXAMPLE V4 -- FROM SLIDING EXHIBITS TO CRITERIA DOC., REF. F
         12:22:49 ON  9/25/80

#
# BEGIN PART 2 OF STABILITY DATA CHECK
#

#
# BEGIN MODULE FA
#

VARIABLE HEELW CALCULATED        8.70 (BW-TW2-TSTB)
VARIABLE HSBPB CALCULATED OR DEFAULTED TO CLOSE COORDINATES,
         HSBPB =  0.193548 IN/FT.
```

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	100.0000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	-0.2500	84.5000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	-0.2500	84.5000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-5.8500	84.5000	TOP OF TOEHT = AT OUTER END OF TW2
5	-5.8500	83.0000	TOE END OF BASE = AT HTE1
6	8.2500	83.0000	TOP OF TOE-SIDE FACE OF KEY
7	8.9500	77.3000	BOTTOM OF TOE-SIDE FACE OF KEY
8	10.4500	77.3000	BOTTOM OF HEEL-SIDE FACE OF KEY
9	10.4500	83.0000	TOP OF HEEL-SIDE FACE OF KEY
10	10.4500	83.0000	HEEL END OF BASE
11	10.4500	84.5000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	1.7500	84.5000	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.5000	100.0000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.5000	100.0000	TOP OF HEEL-SIDE FACE OF STEM

```
# HORIZONTAL NON-SEEPAGE PRESSURES ARE ZERO
# BECAUSE YOUR KRACK VALUE OF 1 CANCELS ACTIVE EARTH
# AND BECAUSE PRESSURES W3 AND/OR W4 (DATA LIST SCWH)
# ARE UNDEFINED, ZERO, OR NEGATIVE.
```

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 1

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	9318.00	0.	81045.82
ACTIVE EARTH	0.	0.	0.
SOIL+WATER	9995.46	0.	100164.53
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	19313.46	0.	181210.36

EXAMPLE V4 -- FROM SLIDING EXHIBITS TO CRITERIA DOC., REF. E
12:22:51 ON 9/25/80

*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:

BACKFILL LAYER	KA VALUE
1	0.4903

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 2
FOR CLASSIC(COULOMB) ANALYSIS IN SA (END OF HEEL)

OUTPUT OF ARRAYS H, FH, AND YH IN MODULE SA FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
86.500	0.	0.
85.500	0.	0.
84.500	0.	0.
83.500	0.	0.
82.500	0.	0.
81.500	0.	0.
80.500	0.	0.
79.500	0.	0.
78.500	0.	0.
77.500	0.	0.
77.300	0.	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 2

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	9318.00	0.	81045.82
ACTIVE EARTH	0.	0.	0.
SOIL+WATER	9995.46	0.	100164.53
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	19313.46	0.	181210.36

EXAMPLE V4 -- FROM SLIDING EXHIBITS TO CRITERIA DOC., REF. E
12:22:54 ON 9/25/80

*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR: .

BACKFILL LAYER	KA VALUE
1	0.4903

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 3
FOR CLASSIC(COULOMB) ANALYSIS IN SA (END OF HEEL)

OUTPUT OF ARRAYS H, EH, AND YH IN MODULE 5A FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
86.500	0.	0.
85.500	0.	0.
84.500	0.	0.
83.500	0.	0.
82.500	0.	0.
81.500	0.	0.
80.500	0.	0.
79.500	0.	0.
78.500	0.	0.
77.500	0.	0.
77.300	0.	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3=W4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 3

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	9318.00	0.	81045.82
ACTIVE EARTH	0.	0.	0.
SOIL+WATER	995.46	0.	100164.53
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	0.	0.
TOTAL	10313.46	0.	181210.36

EXAMPLE V4 -- FROM SLIDING EXHIBITS TO CRITERIA DOC., REF. E
12:22:57 ON 9/25/80

\#
\# BEGIN THE OVERTURNING COMPUTATION
\#

LOAD CASE 1

DEFAULT VALUE OF 1 USED FOR NPPD(LC) (LOAD CASE 1)

RESULTANT IS OUTSIDE THE KERN ON THE TOE SIDE

EFFECTIVE BASE = 15.64 (FT),
COORDINATES OF ZERO PRESSURE ON THE BASE:
XZ = 9.79 AND YZ = 77.30

CREEP PATH DESCRIPTION FOR LOAD CASE 1

X-COORDINATES	Y-COORDINATES	HYDROSTATIC PRESSURE
10.45	97.00	0.
10.45	77.30	1231.25
10.45	77.30	1231.25
9.79	77.30	1231.25
8.95	77.30	1211.43
8.25	83.00	719.78
-5.85	83.00	387.35
-5.85	87.50	0.

OVERTURNING HYDRAULIC GRADIENT = 0.3772

> VALUE OF NPPD(LC) FOUND = 1 IN S/R CHEKIT (LOAD CASE 1)

PASSIVE EARTH PRESSURES FOR LOAD CASE 1

NPPD	=	1	
ELEVATION OF TOP OF SOIL	=	87.559	(FT)
PRESSURE AT TOP OF SOIL	=	0.	(LBS/SQ.FT)
ELEVATION AT BOTTOM OF TOE	=	83.000	(FT)
PRESSURE AT BOTTOM OF TOE	=	-720.91	(LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL	=	77.300	(FT)
PRESSURE AT LOWEST POINT ON WALL	=	-720.91	(LBS/SQ.FT)
PASSIVE EARTH FORCE	=	-5752.3	(LBS/SLICE)
PASSIVE EARTH MOMENT	=	-9214.4	(FT-LBS/SLICE)

```
DISTANCE FROM THE TOE TO THE RESULTANT           =  5.21 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE    =    -1[illegible]319.00 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES    =     5752.78 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES   =  -125128.25 (FT-LBS/SLICE)

THE RESULTANT RATIO =      0.3197, FOR LOAD CASE  1


LOAD CASE   2


DEFAULT VALUE OF          3      USED FOR NPPD(LC)    (LOAD CASE   2)
RESULTANT IS WITHIN THE KERN

CREEP PATH DESCRIPTION FOR LOAD CASE 2
```

X-COORDINATES	Y-COORDINATES	HYDROSTATIC PRESSURE
10.45	97.00	0.
10.45	86.50	656.25
10.45	83.00	815.70
10.45	77.30	1075.37
8.95	77.30	1049.95
8.25	83.00	596.40
-5.85	83.00	357.50
-5.85	87.50	0.

```
OVERTURNING HYDRAULIC GRADIENT  =  0.2711


> VALUE OF NPPD(LC)   FOUND =          3      IN S/R CHEKIT (LOAD CASE   2)


PASSIVE EARTH PRESSURES FOR LOAD CASE  2

NPPD                                  =          3
ELEVATION OF TOP OF SOIL              =    87.559     (FT)
PRESSURE AT TOP OF SOIL               =   0.          (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL     =    77.300     (FT)
PRESSURE AT LOWEST POINT ON WALL      =   -1153.1     (LBS/SQ.FT)
PASSIVE EARTH FORCE                   =   -5914.3     (LBS/SLICE)
PASSIVE EARTH MOMENT                  =   -13488.     (FT-LBS/SLICE)

DISTANCE FROM THE TOE TO THE RESULTANT           =  5.51 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE    =    -8895.18 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES    =     5914.29 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES   =  -110298.34 (FT-LBS/SLICE)

THE RESULTANT RATIO =      0.3382, FOR LOAD CASE  2
```

LOAD CASE 3

DEFAULT VALUE OF 1 USED FOR NPPD(LC) (LOAD CASE 3)

RESULTANT IS WITHIN THE KERN

CREEP PATH DESCRIPTION FOR LOAD CASE 3

X-COORDINATES	Y-COORDINATES	HYDROSTATIC PRESSURE
10.45	97.00	0.
10.45	86.50	656.25
10.45	83.00	815.70
10.45	77.30	1075.37
8.95	77.30	1049.95
8.25	83.00	596.40
-5.85	83.00	357.50
-5.85	87.50	0.

OVERTURNING HYDRAULIC GRADIENT = 0.2711

> VALUE OF NPPD(LC) FOUND = 1 IN S/R CHEKIT (LOAD CASE 3)

PASSIVE EARTH PRESSURES FOR LOAD CASE 3

NPPD	=	1	
ELEVATION OF TOP OF SOIL	=	87.559	(FT)
PRESSURE AT TOP OF SOIL	=	0.	(LBS/SQ.FT)
ELEVATION AT BOTTOM OF TOE	=	83.000	(FT)
PRESSURE AT BOTTOM OF TOE	=	-741.21	(LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL	=	77.300	(FT)
PRESSURE AT LOWEST POINT ON WALL	=	-741.21	(LBS/SQ.FT)
PASSIVE EARTH FORCE	=	-5914.3	(LBS/SLICE)
PASSIVE EARTH MOMENT	=	-9473.9	(FT-LBS/SLICE)

DISTANCE FROM THE TOE TO THE RESULTANT = 5.90 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE = -8895.18 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES = 5914.29 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES = -110298.34 (FT-LBS/SLICE)

THE RESULTANT RATIO = 0.3618, FOR LOAD CASE 3

```
EXAMPLE V4 -- FROM SLIDING EXHIBITS TO CRITERIA DOC., REF. E
        12:22:57 ON  9/25/80

#
# BEGIN SLIDING COMPUTATION
#

     FACTOR OF SAFETY FOR MIN. OMEGA (LEVEL) =     7.42

     SUM OF DRIVING FORCES  =  7711.020 (LBS/SLICE)
     SUM OF RESISTING FORCES =  7715.337 (LBS/SLICE)

     PASSIVE EARTH FORCE                     =    5581.72 (LBS/SLICE)
     ACTIVE EARTH FORCE                      =       0.   (LBS/SLICE)
     UPLIFT FORCE                            = -17092.89 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =    7711.02 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
             X          Y
         -5.85       77.30
          8.95       77.30

     FACTOR OF SAFETY FOR MAX. OMEGA (TOE TO KEY) =     3.99

     SUM OF DRIVING FORCES  =  6230.984 (LBS/SLICE)
     SUM OF RESISTING FORCES =  6234.951 (LBS/SLICE)

     PASSIVE EARTH FORCE                     =    2419.34 (LBS/SLICE)
     ACTIVE EARTH FORCE                      =       0.   (LBS/SLICE)
     UPLIFT FORCE                            = -13611.81 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =    6677.13 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
             X          Y
         -5.85       83.00
          8.95       77.30

FINAL FACTOR OF SAFETY AGAINST SLIDING =      3.99, FOR LOAD CASE  1
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

     SUM OF DRIVING FORCES  =  6230.984 (LBS/SLICE)
     SUM OF RESISTING FORCES =  6234.951 (LBS/SLICE)

     PASSIVE EARTH FORCE                     =    2419.34 (LBS/SLICE)
     ACTIVE EARTH FORCE                      =       0.   (LBS/SLICE)
     UPLIFT FORCE                            = -13611.81 (LBS/SLICE)
     SUMMATION OF HORIZONTAL WATER FORCES =    6677.13 (LBS/SLICE)

      FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
             X          Y
         -5.85       83.00
          8.95       77.30
```

FACTOR OF SAFETY FOR MIN. OMEGA (LEVEL) = 5.97

SUM OF DRIVING FORCES = 7307.532 (LBS/SLICE)
SUM OF RESISTING FORCES = 43612.161 (LBS/SLICE)

PASSIVE EARTH FORCE = 27018.05 (LBS/SLICE)
ACTIVE EARTH FORCE = 0. (LBS/SLICE)
UPLIFT FORCE = -15365.86 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES = 7307.53 (LBS/SLICE)

FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK

X	Y
-5.85	77.30
8.95	77.30

FACTOR OF SAFETY FOR MAX. OMEGA (TOE TO KEY) = 5.53

SUM OF DRIVING FORCES = 6519.603 (LBS/SLICE)
SUM OF RESISTING FORCES = 36026.974 (LBS/SLICE)

PASSIVE EARTH FORCE = 10285.56 (LBS/SLICE)
ACTIVE EARTH FORCE = 0. (LBS/SLICE)
UPLIFT FORCE = -11877.00 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES = 6519.60 (LBS/SLICE)

FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK

X	Y
-5.85	83.00
8.95	77.30

FINAL FACTOR OF SAFETY AGAINST SLIDING = 5.52, FOR LOAD CASE 2
BY SHEAR FRICTION METHOD

SUM OF DRIVING FORCES = 6584.222 (LBS/SLICE)
SUM OF RESISTING FORCES = 36372.907 (LBS/SLICE)

PASSIVE EARTH FORCE = 11772.51 (LBS/SLICE)
ACTIVE EARTH FORCE = 0. (LBS/SLICE)
UPLIFT FORCE = -12234.14 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES = 6584.22 (LBS/SLICE)

FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK

X	Y
-5.85	82.43
8.95	77.30

FACTOR OF SAFETY FOR MIN. OMEGA (LEVEL) = 6.77

SUM OF DRIVING FORCES = 8237.241 (LBS/SLICE)
SUM OF RESISTING FORCES = 8243.476 (LBS/SLICE)

PASSIVE EARTH FORCE = 5814.33 (LBS/SLICE)
ACTIVE EARTH FORCE = 929.71 (LBS/SLICE)
UPLIFT FORCE = -15365.86 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES = 7307.53 (LBS/SLICE)

FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK

X	Y
-5.85	77.30
8.95	77.30

```
FACTOR OF SAFETY FOR MAX, OMEGA (TOE TO KEY) =      4.01

SUM OF DRIVING FORCES  =  6353.994 (LBS/SLICE)
SUM OF RESISTING FORCES =  6353.814 (LBS/SLICE)

PASSIVE EARTH FORCE                        =    2408.43 (LBS/SLICE)
ACTIVE EARTH FORCE                         =     289.34 (LBS/SLICE)
UPLIFT FORCE                               = -11877.00 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =    6519.60 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
        X          Y
      -5.85      83.00
       8.95      77.30

FINAL FACTOR OF SAFETY AGAINST SLIDING =      4.01, FOR LOAD CASE  3
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

SUM OF DRIVING FORCES  =  6353.994 (LBS/SLICE)
SUM OF RESISTING FORCES =  6353.814 (LBS/SLICE)

PASSIVE EARTH FORCE                        =    2408.43 (LBS/SLICE)
ACTIVE EARTH FORCE                         =     289.34 (LBS/SLICE)
UPLIFT FORCE                               = -11877.00 (LBS/SLICE)
SUMMATION OF HORIZONTAL WATER FORCES =    6519.60 (LBS/SLICE)

 FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
        X          Y
      -5.85      83.00
       8.95      77.30
```

EXAMPLE V4 -- FROM SLIDING EXHIBITS TO CRITERIA DOC., REF. E
12:24:28 ON 9/25/80

*
* BEGIN ALLOWABLE BEARING CAPACITY COMPUTATIONS
*

THE BASE LIES IN SOIL 3

FOR LOAD CASE 1,

FOR THE BASE COORDINATES X= -5.85 Y= 83.00, THE ABSOLUTE VALUE OF:
THE ALLOWABLE BEARING PRESSURE = 8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE = 1150.14 (LBS/SQ.FT)

FOR THE BASE COORDINATES X= 8.25 Y= 83.00, THE ABSOLUTE VALUE OF:
THE ALLOWABLE BEARING PRESSURE = 8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE = 113.29 (LBS/SQ.FT)

FOR THE BASE COORDINATES X= 8.95 Y= 77.30, THE ABSOLUTE VALUE OF:
THE ALLOWABLE BEARING PRESSURE = 8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE = 61.82 (LBS/SQ.FT)

FOR THE BASE COORDINATES X= 10.45 Y= 77.30, THE ABSOLUTE VALUE OF:
THE ALLOWABLE BEARING PRESSURE = 8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE = 0. (LBS/SQ.FT)

THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE, 1

FOR LOAD CASE 2,

FOR THE BASE COORDINATES X= -5.85 Y= 83.00, THE ABSOLUTE VALUE OF:
THE ALLOWABLE BEARING PRESSURE = 8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE = 1259.83 (LBS/SQ.FT)

FOR THE BASE COORDINATES X= 8.25 Y= 83.00, THE ABSOLUTE VALUE OF:
THE ALLOWABLE BEARING PRESSURE = 8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE = 185.03 (LBS/SQ.FT)

FOR THE BASE COORDINATES X= 8.95 Y= 77.30, THE ABSOLUTE VALUE OF:
THE ALLOWABLE BEARING PRESSURE = 8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE = 132.72 (LBS/SQ.FT)

FOR THE BASE COORDINATES X= 10.45 Y= 77.30, THE ABSOLUTE VALUE OF:
THE ALLOWABLE BEARING PRESSURE = 8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE = 18.48 (LBS/SQ.FT)

THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE, 2

FOR LOAD CASE 3.

FOR THE BASE COORDINATES X= -5.85 Y= 83.00, THE ABSOLUTE VALUE OF:
THE ALLOWABLE BEARING PRESSURE = 8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE = 1169.19 (LBS/SQ.FT)

FOR THE BASE COORDINATES X= 8.25 Y= 83.00, THE ABSOLUTE VALUE OF:
THE ALLOWABLE BEARING PRESSURE = 8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE = 252.20 (LBS/SQ.FT)

FOR THE BASE COORDINATES X= 8.95 Y= 77.30, THE ABSOLUTE VALUE OF:
THE ALLOWABLE BEARING PRESSURE = 8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE = 206.68 (LBS/SQ.FT)

FOR THE BASE COORDINATES X= 10.45 Y= 77.30, THE ABSOLUTE VALUE OF:
THE ALLOWABLE BEARING PRESSURE = 8000.00 (LBS/SQ.FT)
THE ACTUAL BEARING PRESSURE = 109.12 (LBS/SQ.FT)

THE BEARING CAPACITY OF THE SOIL IS SATISFACTORY FOR LOAD CASE, 3

EXAMPLE V4 -- FROM SLIDING EXHIBITS TO CRITERIA DOC., REF. E
12:24:29 ON 9/25/80

#
BEGIN COST ANALYSIS
#

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	95.15	0.	0.

COST & VOLUME OF BACKFILL MATERIAL,

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	30.59	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	32.64	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	27.13	1.00	27.13
BASE	24.45	1.00	24.45
KEY	10.54	1.00	10.54

TOTAL CONCRETE VOLUME = 62.12 (CU FT / LF), FOR LOAD CASE 1

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	95.15	0.	0.

COST & VOLUME OF BACKFILL MATERIAL,

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	30.59	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	32.64	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	27.13	1.00	27.13
BASE	24.45	1.00	24.45
KEY	10.54	1.00	10.54

TOTAL CONCRETE VOLUME = 62.12 (CU FT / LF), FOR LOAD CASE 2

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	95.15	0.	0.

COST & VOLUME OF BACKFILL MATERIAL,

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	30.59	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	32.64	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	27.13	1.00	27.13
BASE	24.45	1.00	24.45
KEY	10.54	1.00	10.54

TOTAL CONCRETE VOLUME = 62.12 (CU FT / LF), FOR LOAD CASE 3

#
BEGIN SOIL CONTROL CALCULATIONS FOR LOAD CASE 1
#

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF 77.30 IS 2.6323

#
BEGIN SOIL CONTROL CALCULATIONS FOR LOAD CASE 2
#

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF 77.30 IS 3.0007

#
BEGIN SOIL CONTROL CALCULATIONS FOR LOAD CASE 3
#

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF 77.30 IS 3.0007

```
EXAMPLE V4 -- FROM SLIDING EXHIBITS TO CRITERIA DOC., REF. E
          12:24:31 ON  9/25/80

#
# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#

  COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
     BACKFILL LAYER           KA VALUE
     **************           ********
           1                   0.4961

            HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  1
            FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

            OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

              ELEVATION  INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                              STATIC FORCE           EARTHQUAKE FORCE
                 (FT)          (LBS/FT)                 (LBS/FT)
              ---------  ----------------------  ----------------------
               86.500            0.                      0.
               85.500            0.                      0.
               84.500            0.                      0.

            FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

            RESULTANT HORIZONTAL STATIC ACTIVE FORCE =        0.    LBS/HORIZ FT
            ACTING AT ELEVATION      0.

            RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
            DUE TO EARTHQUAKE =        0.    LBS/HORIZ FT
            ACTING AT ELEVATION      0.
```

```
EXAMPLE V4 -- FROM SLIDING EXHIBITS TO CRITERIA DOC., REF. E
          12:24:32 ON  9/25/80

#
# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#

  COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
     BACKFILL LAYER          KA VALUE
     **************          ********
           1                  0.4961

            HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  2
            FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

            OUTPUT OF ARRAYS HS, EHS, AND YVB IN MODULE SP FOR CLASSIC ANALYSIS.

              ELEVATION  INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                              STATIC FORCE          EARTHQUAKE FORCE
                 (FT)          (LBS/FT)                 (LBS/FT)
              ---------  ----------------------  ----------------------
             86.500            0.                       0.
             85.500            0.                       0.
             84.500            0.                       0.

            FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

            RESULTANT HORIZONTAL STATIC ACTIVE FORCE =        0.    LBS/HORIZ FT
            ACTING AT ELEVATION      0.

            RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
            DUE TO EARTHQUAKE =        0.    LBS/HORIZ FT
            ACTING AT ELEVATION      0.
```

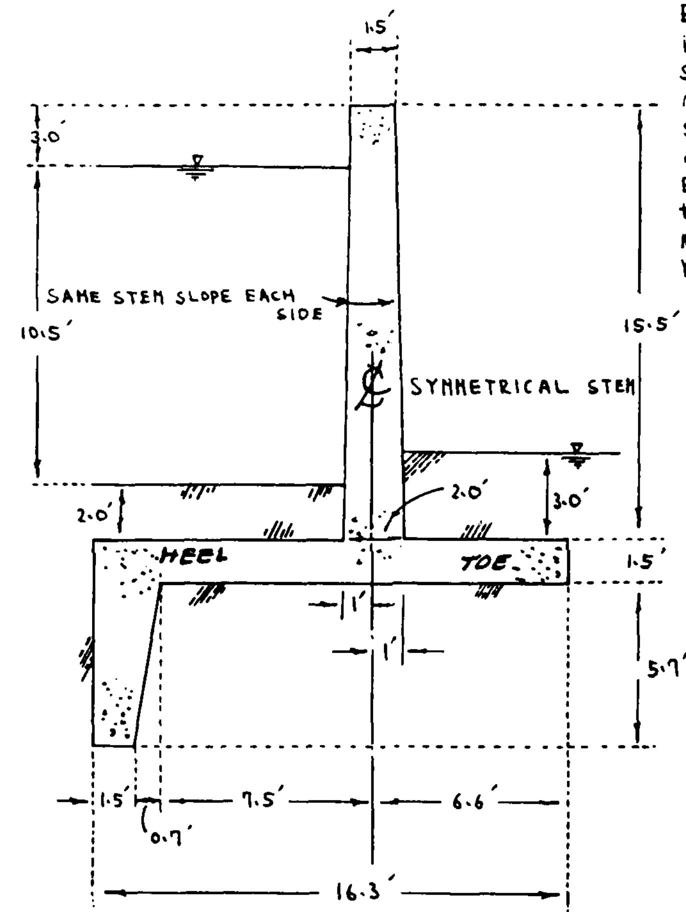
```
#
# BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
#


  COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
     BACKFILL LAYER          KA VALUE
     ---------------         --------
           1                  0.4961


          HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  3
          FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)


          OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

           ELEVATION  INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                          STATIC FORCE           EARTHQUAKE FORCE
             (FT)          (LBS/FT)                 (LBS/FT)
           ---------  ----------------------  ----------------------
            86.500          0.                       0.
            85.500          0.                       0.
            84.500          0.                       0.


          FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

          RESULTANT HORIZONTAL STATIC ACTIVE FORCE =        0.   LBS/HORIZ FT
          ACTING AT ELEVATION      0.

          RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
          DUE TO EARTHQUAKE =        0.   LBS/HORIZ FT
          ACTING AT ELEVATION      0.


#
# EXIT MODULE EA
#


 #
 # UPDATE FILE RESET
 #

 COMMAND ENTERED:
 END
```

5-5 HAND CALCULATIONS

5-5-1 Load Case 2 Sliding:

SUBJECT	COMPUTED BY	DATE	FILE NO.
EXHIBIT H SAMPLE RETAINING WALL SHEAR FRICTION SLIDING ANALYSIS	CHECKED BY	DATE	SHEET NO. /

Exhibit H illustrates the shear friction method for SLIDING ANALYSIS AS GIVEN IN ETL 1110-2-184, the default method for retaining walls



$\gamma_c = 0.150$ kcf

$\gamma_w = 0.0625$ kcf

$\gamma_{sat} = 0.125$ kcf

$\phi = 20°$

$c = 0.35$ tsf $= 0.7$ ksf

$k_A = \tan^2(45 - \phi/2)$ *

$k_P = \tan^2(45 + \phi/2)$ *

* COHESION EFFECT NOT SHOWN HERE

SUBJECT EXHIBIT H

SAMPLE RETAINING WALL

SHEAR FRICTION SLIDING ANALYSIS

SHEET NO. 2

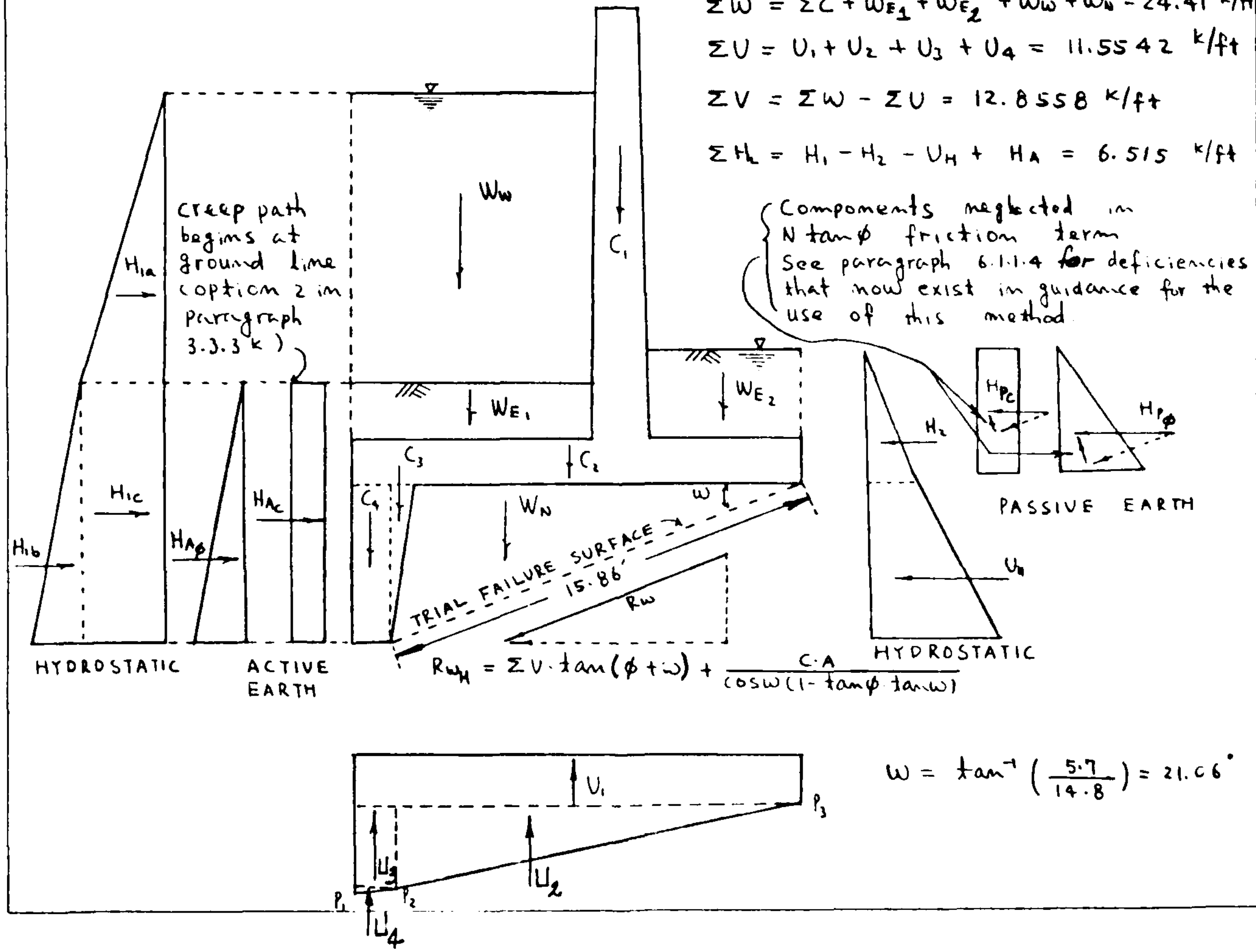
$$H_1 = H_{1a} + H_{1b} + H_{1c} = 11.316 \text{ k/ft}$$

$$\Sigma W = \Sigma C + W_{E_1} + W_{E_2} + W_W + W_N = 24.41 \text{ k/ft}$$

$$\Sigma U = U_1 + U_2 + U_3 + U_4 = 11.5542 \text{ k/ft}$$

$$\Sigma V = \Sigma W - \Sigma U = 12.8558 \text{ k/ft}$$

$$\Sigma H_L = H_1 - H_2 - U_H + H_A = 6.515 \text{ k/ft}$$



$$R_{W_H} = \Sigma V \cdot \tan(\phi + \omega) + \frac{C \cdot A}{\cos\omega(1 - \tan\phi \tan\omega)}$$

$$\omega = \tan^{-1}\left(\frac{5.7}{14.8}\right) = 21.66^\circ$$

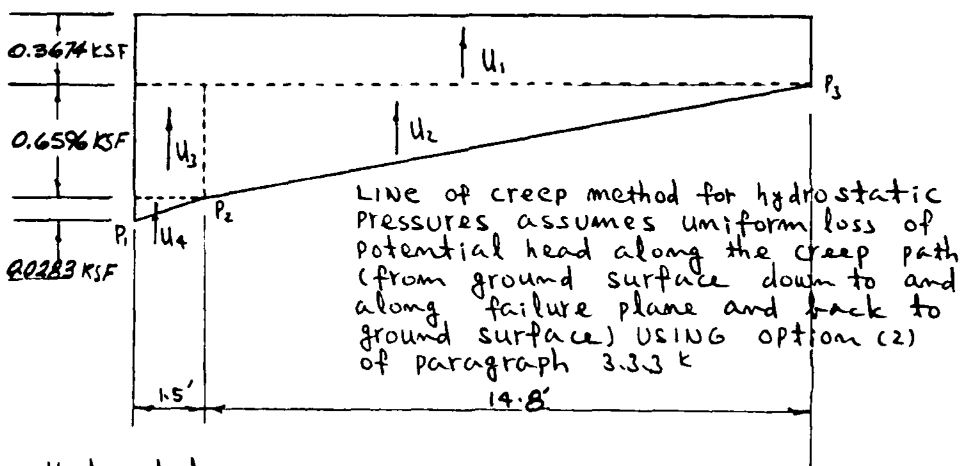
SUBJECT: EXHIBIT H SAMPLE RETAINING WALL SHEAR FRICTION SLIDING ANALYSIS	COMPUTED BY: CHECKED BY:	DATE: DATE:	FILE NO. SHEET NO. 3

CALCULATE HYDROSTATIC UPLIFT:

Net Head $(\Delta H) = 15.5 - 3 - 3 = 9.5$ FT

Creep path $(L_c) = 9.2 + 1.5 + \sqrt{14.8^2 + 5.7^2}$
$+ 1.5 + 3.0$
$= 9.2 + 1.5 + 15.86 + 1.5 + 3.0$
$= 31.06$ FT.

$$\frac{\Delta H}{L_c} = \frac{9.5}{31.06} = 0.306 = \text{hydraulic gradient}$$



Hydrostatic pressures:

P @ base of H1a $= 0.0625\,(10.5) = 0.65625$ ksf

$P_1 = 0.65625 + 0.0625\,(9.2) - 0.306\,(9.2)(0.0625) = 1.0553$ ksf

$P_2 = 1.0553 - 1.5\,(0.306)(0.0625) = 1.027$ ksf

$P_3 = 1.027 - (0.0625)(5.7) - (0.306)(15.86)(0.0625) = 0.3674$ ksf

P @ ground over toe $= 0.3674 - 4.5(0.0625) - 0.306(4.5)(0.0625)$
≈ 0

SUBJECT EXHIBIT H SAMPLE RETAINING WALL SHEAR FRICTION SLIDING ANALYSIS	COMPUTED BY	DATE	FILE NO.
	CHECKED BY	DATE	SHEET NO. 4

UPLIFT FORCES :

$$\left.\begin{aligned}
U_1 &= 0.3674\,(16.3) = 5.9886 \text{ k/ft} \\
U_2 &= (1.027 - 0.3674)(14.8)(\tfrac{1}{2})(\cos 21.06) = 4.555 \text{ k/ft} \\
U_3 &= (1.027 - 0.3674)(1.5) = 0.9894 \text{ k/ft} \\
U_4 &= (1.0553 - 1.027)(1.5)(\tfrac{1}{2}) = 0.0212 \text{ k/ft}
\end{aligned}\right\} \Sigma U = 11.5542 \text{ k/ft}$$

SUBJECT	COMPUTED BY	DATE	FILE NO.
EXHIBIT H SAMPLE RETAINING WALL SHEAR FRICTION SLIDING ANALYSIS	CHECKED BY	DATE	SHEET NO. 5

SYMBOL	FACTORS	FORCE →	FORCE ←	FORCE ↓	FORCE ↑
C_1	$\frac{1}{2}(1.5+2.0)(15.5)(0.15)$			4.07	
C_2	$1.5(16.3)(0.15)$			3.67	
C_3	$\frac{1}{2}(0.7)(5.7)(0.15)$			0.30	
C_4	$(1.5)(5.7)(0.15)$			1.28 9.32	
WE_1	$(2)(8.7)(0.125)$ $\frac{1}{2}(2)\left[(2)\left(\frac{0.25}{15.5}\right)\right](0.125)$			2.17 0.00 2.17	
WE_2	$(3)(0.125)(5.6)$ $\frac{1}{2}(3)\left[(3)\left(\frac{0.25}{15.5}\right)\right](0.125)$			2.10 0.01 2.11	
W_W above E_1	$(10.5)(0.0625)(8.73)$ $\frac{1}{2}(10.5)\left[(10.5)\left(\frac{0.25}{15.5}\right)\right](0.0625)$			5.73 0.06 5.79	
W_N	$\frac{1}{2}(14.8)(5.7)(0.125)$ $-\frac{1}{2}(0.7)(5.7)(0.125)$			5.27 -0.25 5.02	
	$C + W_E + W_W + W_N$			24.41	
H_{1a}	$0.656(10.5)(\frac{1}{2})$	3.444			
H_{1b}	$(1.0553-0.656)(9.2)(\frac{1}{2})$	1.837			
H_{1c}	$0.656(9.2)$	6.035			
H_2	$0.3674(4.5)(\frac{1}{2})$		0.827		
U_H	$\frac{1.027+0.3674}{2}(5.7)$		3.974		
H_A	$\frac{0.0625(9.2)^2}{2}\left[\tan^2(45^\circ-\frac{20^\circ}{2})\right]$ $-2(0.7)(9.2)\left[\tan(45^\circ-\frac{20^\circ}{2})\right]$	1.297 -9.019	} 0 use because neglecting active pressure cannot exist		
$H_{1a}+H_{1b}+H_{1c}-H_2-U_H+H_A$		6.515			

SUBJECT EXLBIT H SAMPLE RETAINING WALL SHEAR FRICTION SLIDING ANALYSIS	COMPUTED BY:	DATE	FILE NO.
	CHECKED BY:	DATE:	SHEET NO. 6

$$H_{P_c} = 2ch\sqrt{K_P} = 2ch\sqrt{\tan^2(45^\circ + \phi/2)} = 2(0.7)(4.5)\sqrt{\tan^2(45^\circ + \phi/2)}$$

$$H_{P_c} = 8.997 \text{ KIPS}$$

$$H_{P\phi} = \tfrac{1}{2}\gamma h^2 K_P = \tfrac{1}{2}\gamma h^2 \tan^2(45^\circ + \phi/2) = \tfrac{1}{2}(0.0625)(4.5)^2 \tan^2(45^\circ + 20/2)$$

$$H_{P\phi} = 1.291 \text{ KIPS}$$

$$\Sigma H_P = \Sigma H_{P_c} + \Sigma H_{P\phi} = 8.997 + 1.291 = 10.288 \text{ KIPS}$$

THE SHEAR-friction safety factor against sliding as given in ETL 1110-2-184, is obtained by dividing the horizontal sliding resistance (ΣR) obtained from resisting forces including those along the critical path (plane or combination of planes which offers the least resistance to sliding) by the summation of horizontal service loads (ΣH) to be applied to the structure.

$$\Sigma V = 24.41 - 11.5542 = 12.8558^{k}$$

$$\Sigma R = \Sigma V \cdot \tan(\phi + \omega) + \frac{C \cdot A}{\cos\omega\,[1 - \tan\phi \cdot \tan\omega]} + H_P$$

$$= 12.8558 \cdot \tan(20^\circ + 21.06^\circ) + \frac{(0.7)(15.86)}{\cos 21.06^\circ\,[1 - \tan 20^\circ \cdot \tan 21.06^\circ]} + 10.288$$

$$= 11.19 + 13.836 + 10.288$$

$$= 35.323 \text{ KIPS}$$

ΣH from sheet H-2

shear-friction safety factor against sliding along the total surface on sheet H-2:

$$F_s = \frac{\Sigma R}{\Sigma H} = \frac{35.323}{6.515} = 5.42$$

SUBJECT EXHIBIT H	COMPUTED BY	DATE	FILE NO.
SAMPLE RETAINING WALL SHEAR FRICTION SLIDING ANALYSIS	CHECKED BY:	DATE:	SHEET NO. 9

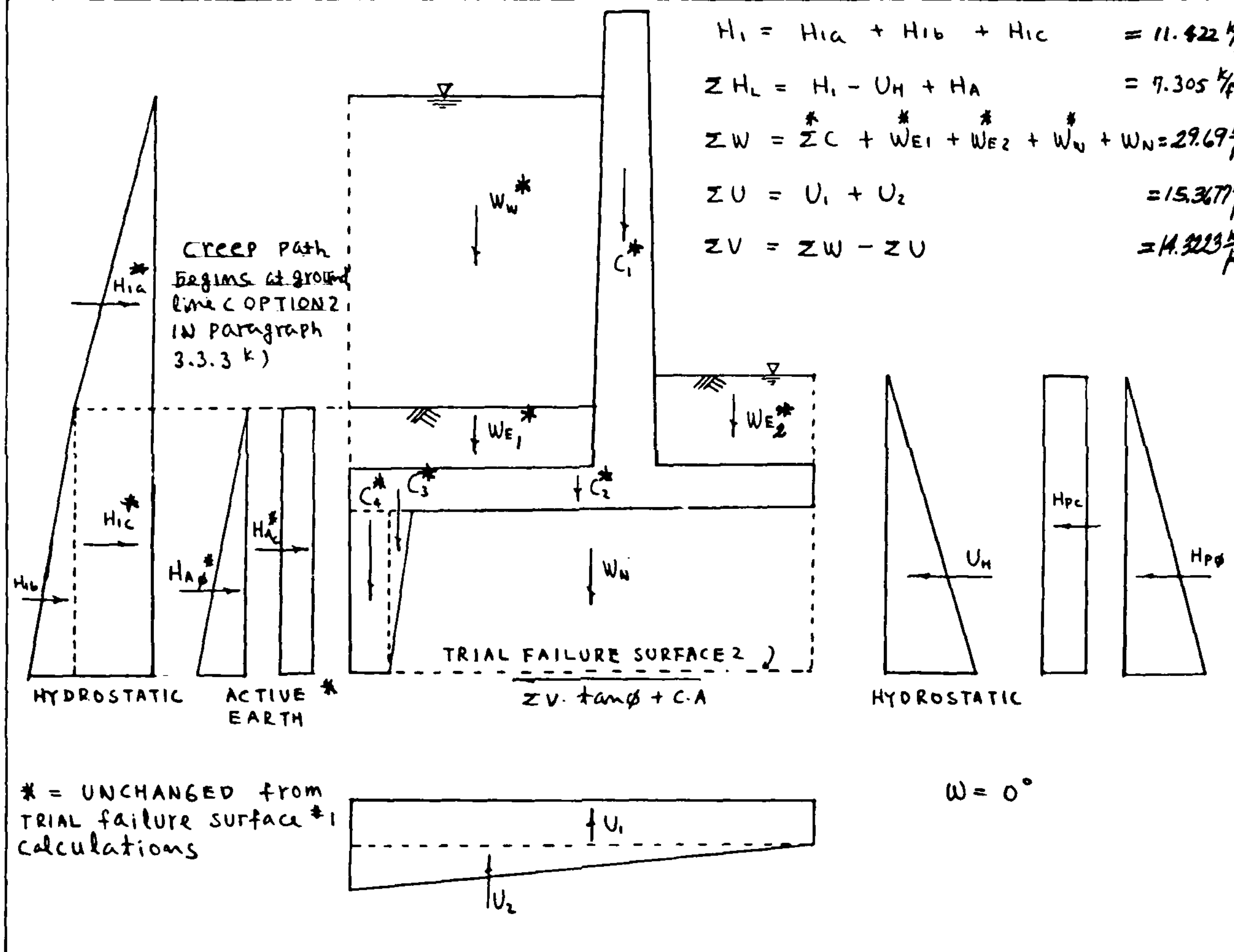
$H_1 = H_{1a} + H_{1b} + H_{1c} = 11.422\ ^k/_{ft}$

$\Sigma H_L = H_1 - U_H + H_A = 7.305\ ^k/_{ft}$

$\Sigma W = \overset{*}{\Sigma C} + \overset{*}{W_{E1}} + \overset{*}{W_{E2}} + \overset{*}{W_W} + W_N = 29.69\ ^k/_{ft}$

$\Sigma U = U_1 + U_2 = 15.3677\ ^k/_{ft}$

$\Sigma V = \Sigma W - \Sigma U = 14.3223\ ^k/_{ft}$



SUBJECT EXHIBIT H SAMPLE RETAINING WALL SHEAR FRICTION SLIDING ANALYSIS	COMPUTED BY CHECKED BY	DATE DATE	FILE NO. SHEET NO. 8

SYMBOL	FACTORS	FORCE →	FORCE ←	FORCE ↓	FORCE ↑
C_1	$\frac{1}{2}(1.5+2.0)(15.5)(0.15)$			4.07	
C_2	$1.5\,(16.3)(0.15)$			3.67	
C_3	$\frac{1}{2}(0.7)(5.7)(0.15)$			0.30	
C_4	$(1.5)(5.7)(0.15)$			1.28 9.32	
W_{E_1}	$(2)(8.7)(0.125)$ $\frac{1}{2}(2)\left[(2)\left(\frac{0.25}{15.5}\right)\right](0.125)$			2.17 0.00 2.17	
W_{E_2}	$(3)(0.125)(5.6)$ $\frac{1}{2}(3)\left[(3)\left(\frac{0.25}{15.5}\right)\right](0.125)$			2.10 0.01 2.11	
W_W above E_1	$(10.5)(0.0625)(8.73)$ $\frac{1}{2}(10.5)\left[(10.5)\left(\frac{0.25}{15.5}\right)\right](0.0625)$			5.73 0.06 5.79	
W_N	$(0.125)(14.8)(5.7)$ $-(0.125)(0.7)(5.7)(0.5)$			10.55 -0.25 10.30	
$C + W_E + W_W + W_N$				29.69	
H_{1a}	$0.656(10.5)(\frac{1}{2})$	3.444			
H_{1b}	$(1.0783-0.656)(9.2)(\frac{1}{2})$	1.943			
H_{1c}	$0.656\,(9.2)$	6.035			
U_H	$(0.5)(10.2)(0.8073)$		4.117		
H_A	$\frac{0.0625(9.2)^2}{2}\left[\tan^2\left(45^\circ-\frac{20^\circ}{2}\right)\right]$ $-2.0(0.7)(9.2)\left[\tan\left(45^\circ-\frac{20^\circ}{2}\right)\right]$	1.297 -9.019	0		
$H_{1a} + H_{1b} + H_{1c} - U_H + H_a =$		7.305			

SUBJECT EXHIBIT H SAMPLE RETAINING WALL SHEAR FRICTION SLIDING ANALYSIS	COMPUTED BY CHECKED BY	DATE DATE	FILE NO. SHEET NO. 9

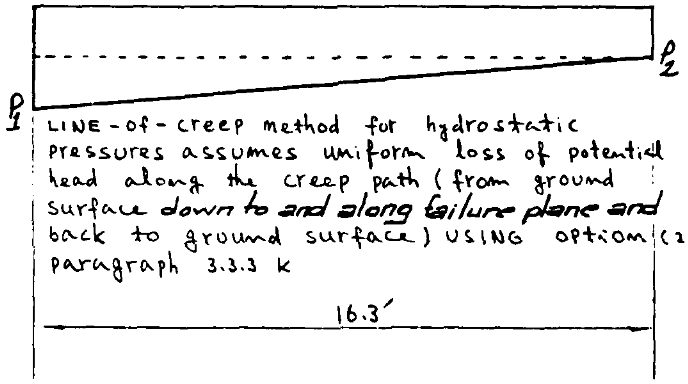
CALCULATE HYDROSTATIC UPLIFT :

Net Head (ΔH) = 15.5 − 3 − 3 = 9.5′

Creep path (L_c) = 9.2 + 16.3 + 5.7 + 1.5 + 3.0

= 35.7 FT.

$$\frac{\Delta H}{L_c} = \frac{9.5}{35.7} = 0.266$$ = hydraulic gradient



Hydrostatic Pressures :

P @ base of H1a = 0.0625 (10.5) = 0.65625 ksf

P_1 = 0.65625 + 0.0625 (9.2) − 0.266 (9.2)(0.0625) = 1.0783

P_2 = 1.0783 − 0.266 (16.3) (0.0625) = 0.8073

UPLIFT FORCES :

U_1 = (0.8073)(16.3) = 13.1590 k/′

U_2 = (0.5)(16.3)(0.271) = 2.2087 k/′

ΣU = 15.3677 k/′

SUBJECT EXHIBIT H ~~SAMPLE~~ RETAINING WALL SHEAR FRICTION SLIDING ~~ANALYSIS~~	COMPUTED BY:	DATE	FILE NO.
	CHECKED BY:	DATE	SHEET NO. 10

the forces which change due to checking trial failure surface 2 is W_N, the resistance forces, driving forces affected by changes in uplift forces over new creep path, and uplift forces (verticals).

$$W_N = (0.125)(14.8)(5.7) = 10.55$$
$$-(0.125)(0.7)(5.7)(0.5) = -0.25$$
$$\overline{\quad 10.30}$$

$$\Sigma V = \Sigma C + W_{E1} + W_{E2} + W_W + W_N - U$$
$$= 9.32 + 2.17 + 2.11 + 5.79 + 10.30 - 15.3677$$
$$= 14.32 \text{ kips}$$

$$H_{P_\phi} = \tfrac{1}{2}(10.2)^2(0.0625)(\tan^2(45° + 20/2))$$
$$= 3.25\,(2.04) = 6.63 \text{ kips}$$

$$H_{P_c} = 2\,(0.7)(10.2)\sqrt{\tan^2(45° + 20/2)}$$
$$= 20.39 \text{ kips}$$

$$H_P = H_{P\phi} + H_{Pc} = 6.63 + 20.39 = 27.02 \text{ kips}$$

$$\Sigma R = \Sigma V \cdot \tan\phi + C \cdot A + H_P$$
$$= 14.32 \tan 20° + 0.7\,(14.8) + 27.02$$
$$= 5.212 + 10.36 + 27.02$$
$$= 42.592$$

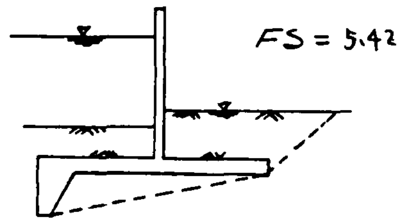
shear friction safety factor against sliding (Trial failure surface 2) $= S.F = \dfrac{\Sigma R}{\Sigma H} = \dfrac{42.592}{7.305}$

$$= 5.83$$

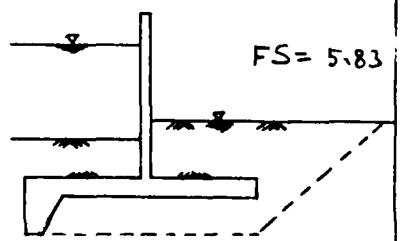
SUBJECT: EXHIBIT H SAMPLE RETAINING WALL SHEAR FRICTION SLIDING ANALYSIS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE:	SHEET NO 11

SUMMARY

Failure Surface #1



Failure Surface #2



So, for these two limiting failure planes, FS = 5.42

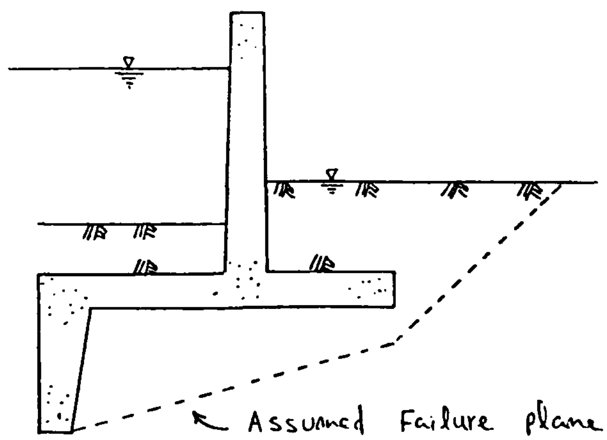
SUBJECT EXHIBIT H SAMPLE RETAINING WALL SHEAR FRICTION SLIDING ANALYSIS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE:	SHEET NO. 12

The total base-foundation interface of the T-wall may not be in compression with the foundation. If any part of the surface under consideration is along the base-foundation interface and is not in contact with the foundation, this portion should be neglected when obtaining the effective base area to resist sliding. However, if the assumed failure surface is not along the base-foundation interface but through the soil, no reduction in the area to resist sliding is made.

A portion of the base of a T-wall will not be in compression when the resultant falls outside the kern thus creating a crack which can result in an increase in uplift pressures. This condition will affect the sliding stability analysis when the assumed sliding plane acts along the soil-structure interface below the base of the wall (for this condition the program will have to recycle back through the line of creep calculations until the creep path assumptions match the final part of the base that is in contact

SUBJECT: EXHIBIT H SAMPLE RETAINING WALL SHEAR FRICTION SLIDING ANALYSIS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE:	SHEET NO. 13

with the foundation). For example, consider a wall without a key and with a horizontal base, when the resultant falls outside the kern and the assumed sliding plane is along the interface between the base of the structure and the soil foundation, uplift pressures will be computed assuming no creep loss for the portion of the foundation not in compression. For the condition where the resultant falls outside the kern but the assumed sliding plane is through the soil, for example a wall with a key positioned at the extreme end of the heel (see figure shown below), no increase in uplift pressure will be considered because the soil does not lift and form a crack as is the case at the soil-structure interface.



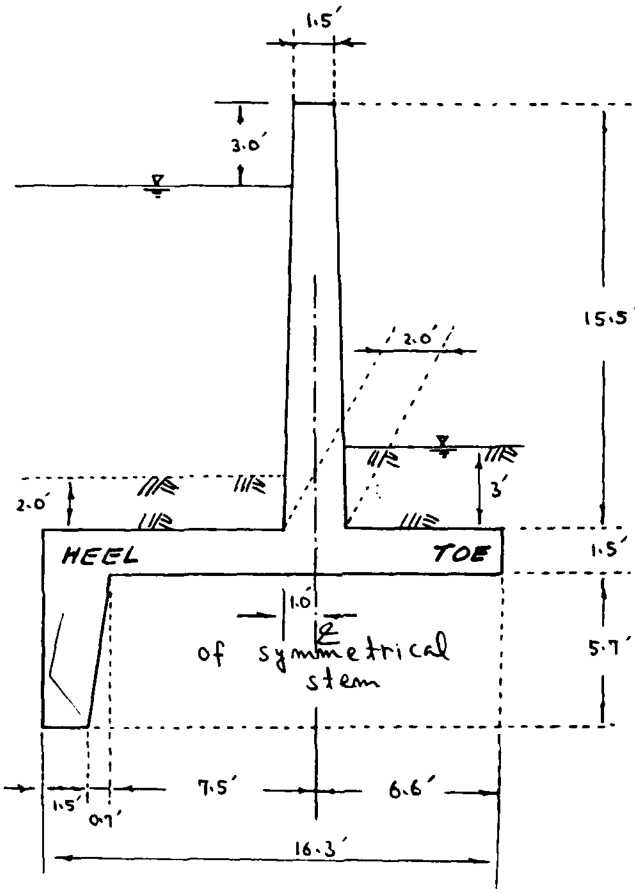
SUBJECT EXHIBIT H SAMPLE RETAINING WALL SHEAR FRICTION SLIDING ANALYSIS	COMPUTED BY: CHECKED BY:	DATE: DATE:	FILE NO. SHEET NO. 14

Another reason the uplift forces are not affected for this condition is because they are forces inside the soil-structure free body and therefore, do not affect the overall sliding stability.

The ϕ and C values should be consistent with the material being sheared. A plane of failure through the soil should use the ϕ and C of the soil. For any of the failure planes along the soil-structure interface, use the ϕ and C for sliding friction at the interface.

5-5-2 <u>Load Case 3 Sliding:</u>

EXHIBIT I SAMPLE FLOODWALL SLIDING ANALYSIS	DATE	FILE NO.
$\tan\phi' = \frac{\tan\phi}{FS}$ AND $c' = \frac{c}{FS + 2C'}$	DATE	SHEET NO. 1



γ_c = 150 pcf $\qquad \phi = 20°$ $\qquad$ c = 0.35 tsf = 0.7 ksf

γ_w = 62.5 pcf

γ_{sat} = 125 pcf $\qquad K_a = \tan^2(45° - \phi/2)$ $\qquad K_p = \tan^2(45° + \phi/2)$

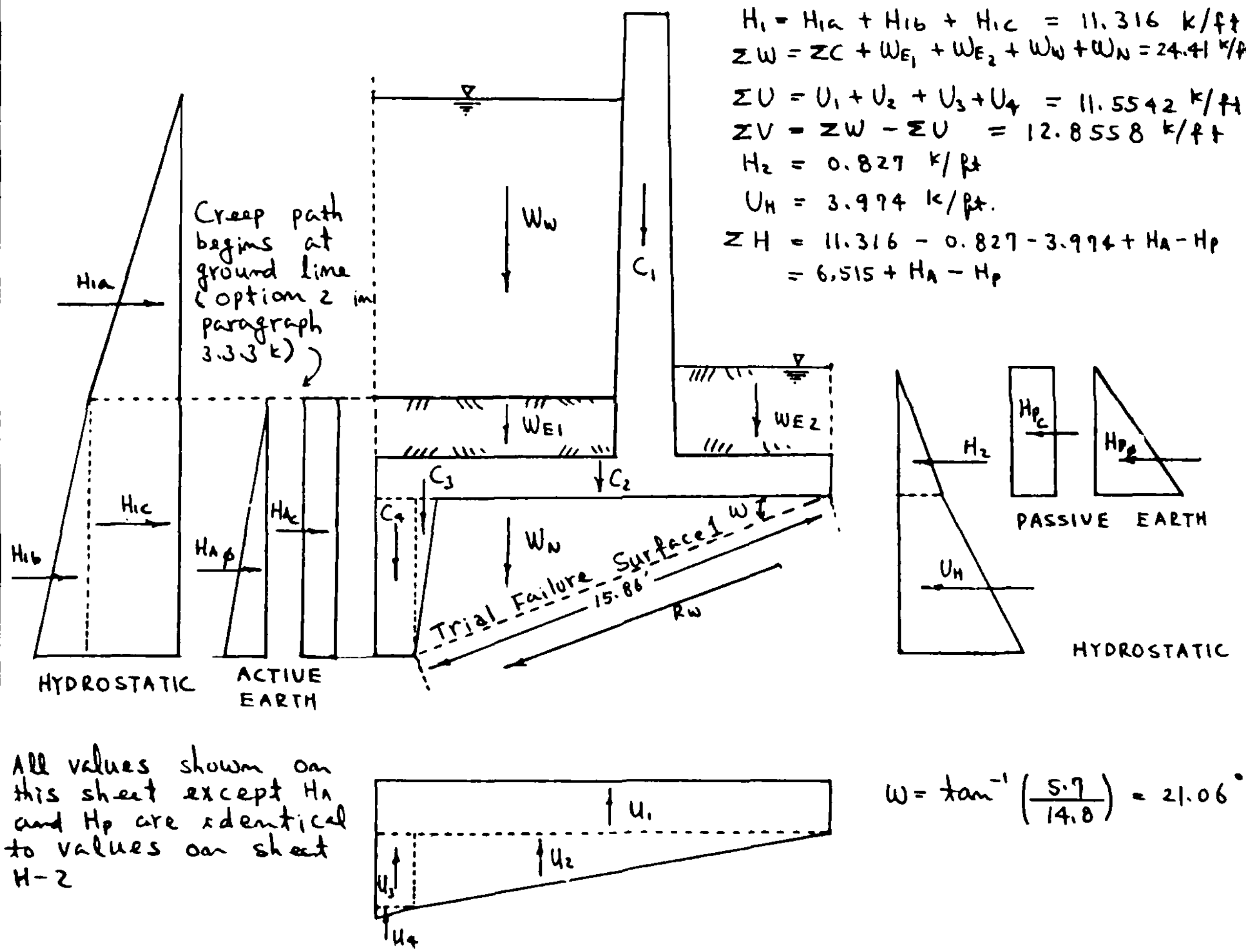
While the flood wall manual, EM 1110-2-2501, does not provide a clear-cut procedure for computing the factor of safety against sliding, a method is presented here that complies with the provisions of this manual. This method is the program default procedure for flood walls.

SUBJECT **EXHIBIT I**

SAMPLE FLOODWALL SLIDING ANALYSIS

COMPUTED BY:	DATE:	FILE NO.
CHECKED BY:	DATE:	SHEET NO. 2

$$H_1 = H_{1a} + H_{1b} + H_{1c} = 11.316 \text{ k/ft}$$
$$\Sigma W = \Sigma C + W_{E_1} + W_{E_2} + W_W + W_N = 24.41 \text{ k/ft}$$
$$\Sigma U = U_1 + U_2 + U_3 + U_4 = 11.5542 \text{ k/ft}$$
$$\Sigma V = \Sigma W - \Sigma U = 12.8558 \text{ k/ft}$$
$$H_2 = 0.827 \text{ k/ft}$$
$$U_H = 3.994 \text{ k/ft}$$
$$\Sigma H = 11.316 - 0.827 - 3.994 + H_A - H_P = 6.515 + H_A - H_P$$

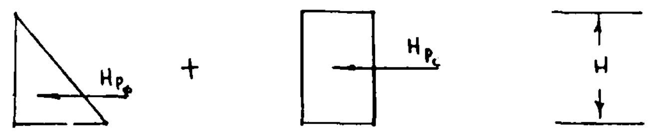


$$\omega = \tan^{-1}\left(\frac{5.7}{14.8}\right) = 21.06^\circ$$

All values shown on this sheet except H_A and H_P are identical to values on sheet H-2

SUBJECT EXHIBIT I SAMPLE FLOODWALL SLIDING ANALYSIS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE:	SHEET NO. 3

PASSIVE EARTH RESISTANCE AT TOE OF WALL



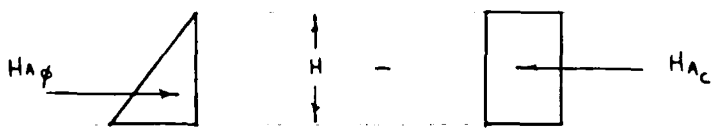
$$H_{P_w} = (H_{P_\phi} + H_{P_c}) \cos 21.06^\circ$$

$$= \left[\tfrac{1}{2}\gamma_b k_p \cdot H^2 + 2c' H\sqrt{k_p}\right] \cos 21.06^\circ$$

$$= \left[\tfrac{1}{2}(0.125-0.0625)\, k_p \cdot (4.5)^2 + 2c'(4.5)\sqrt{k_p}\right] \cos 21.06^\circ$$

$$= 0.5905\, k_p + 8.399 c' \sqrt{k_p}$$

ACTIVE EARTH DRIVING FORCE AT HEEL OF WALL



$$H_{A_w} = (H_{A\phi} - H_{A_c}) \cos 21.06^\circ$$

$$= \tfrac{1}{2}\gamma_b k_A H^2 \cdot \cos 21.06^\circ - 2c' H\sqrt{k_A} \cos 21.06^\circ$$

$$= \tfrac{1}{2}(0.125 - 0.0625)\, k_A \cdot (9.2)^2 \cdot \cos 21.06^\circ$$

$$- 2 \cdot c' \cdot (9.2)\sqrt{k_A} \cdot \cos 21.06^\circ$$

$$= 2.4683\, k_A - 17.1710 c' \sqrt{k_A}$$

SUBJECT EXHIBIT I SAMPLE FLOODWALL SLIDING ANALYSIS	COMPUTED BY	DATE	FILE NO.
	CHECKED BY	DATE	SHEET NO. 4

NET APPLIED FORCE TENDING TO INDUCE SLIDING

$\Sigma D_w = (H_1 - H_2 - U_H)\cos w + H_{A_w}$ (See sheet H-5 for H_1, H_2 & U_H values)

$= (11.316 - 0.827 - 3.974)\cos 21.06 + 2.4683\,k_A - 17.1710\,C'\sqrt{k_A}$

$= 6.08 + 2.4683\,k_A - 17.1710\,C'\sqrt{k_A}$

REACTION FORCES TENDING TO RESIST SLIDING

$\Sigma R_w = H_{R_w} + H_{P_w} = [\Sigma V \cdot \cos w + \Sigma H \cdot \sin w] \tan\phi' + C' \cdot A + H_{P_w}$

$= [12.8558 \cdot \cos 21.06 + \{11.316 - 0.827 - 3.974\} \sin 21.06° +$
$\{\frac{1}{2}(0.125 - 0.0625) \cdot k_A \cdot (9.2)^2 - 2 \cdot C'(9.2)\sqrt{k_A}\} \sin 21.06° -$
$\{\frac{1}{2}(0.125 - 0.0625) \cdot k_P \cdot (4.5)^2 + 2 \cdot C'(4.5)\sqrt{k_P}\} \cdot \sin 21.06°] \cdot \tan\phi' +$
$15.86C' + 0.5905\,k_P + 8.399 \cdot C'\sqrt{k_P}$

$= [14.338 + 0.9505\,k_A - 6.612\,C'\sqrt{k_A} - 0.2274\,k_P - 3.23411\,C'\sqrt{k_P}] \cdot \tan\phi' +$
$15.86C' + 0.5905\,k_P + 8.399 \cdot C'\sqrt{k_P}$

EQUILIBRIUM OF APPLIED AND REACTION FORCES CONSIDERING TRIAL FAILURE SURFACE 1

WITH $[\Sigma D_w = f_1(FS, FS + 2C')$ AND $\Sigma R_w = f_2(FS, FS + 2C')]$, the equilibrium relationship $[\Sigma D_w = \Sigma R_w]$ becomes $[f_1(FS, FS + 2C') = f_2(FS, FS + 2C')]$ which can be transposed to read $[f_1(FS, FS + 2C') - f_2(FS, FS + 2C') = 0]$

The computation of FS involves solving the expression

$$\Sigma D_w - \Sigma R_w = 0$$

$$f_1(FS, FS + 2C') - f_2(FS, FS + 2C') = 0$$

by an iterative procedure, either graphically (by hand) or analytically (on the computer). The procedure includes (1) assuming a trial value of FS, (2) calculating allowable values of ϕ' and c', (3) calculating k_A and k_P from ϕ', (4) substituting c', k_A, and k_P into ΣD_w and ΣR_w, and (5) either plotting $\Sigma D_w = f_1(FS, FS + 2C')$ and $\Sigma R_w = f_2(FS, FS + 2C')$ to get the the point of intersection or solving for FS to make $\Sigma D_w - \Sigma R_w = 0$

SUBJECT: EXHIBIT I SAMPLE FLOODWALL SLIDING ANALYSIS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE:	SHEET NO. 5

An example of the above procedure is as follows:

$$\phi' = \tan^{-1}\left(\frac{\tan\phi}{FS}\right) \qquad \text{where} \quad \phi = 20°$$

$$c' = \frac{c}{FS + 2q} \qquad \text{where} \quad q = c'$$

$c = 0.35$ tsf

the positive value of c' is

$$c' = \frac{\sqrt{FS^2 + 8c} - FS}{4}$$

where c and c' is in tsf

For $FS = 1$

$$\phi' = \tan^{-1}\left(\frac{\tan 20°}{1}\right)$$

$$= 20°$$

$$c' = \frac{\sqrt{(1)^2 + 8(0.35)} - 1}{4} = 0.23734 \text{ tsf}$$

or 0.47468 ksf

$\tan\phi' = \tan 20° = 0.36397$

$k_A = \tan^2(45° - \phi'/2) = \tan^2(45° - 20°/2) = 0.49029$

$k_P = \tan^2(45° + \phi'/2) = \tan^2(45° + 20°/2) = 2.03961$

$\sqrt{k_P} = \sqrt{2.03961} = 1.42815$

$H_{A_w} = 2.4683\, k_A - 17.1710\, c'\sqrt{k_A}$

$= 1.21018 - 5.70720 = -4.50$ (neglect if negative)

$zD_w = 6.08 + 2.4683\, k_A - 17.1710\, c'\sqrt{k_A} = 6.08 + H_{A_w}$

$= 6.08 \underbrace{\cancel{-4.50}}_{\text{neglect}} = 6.08$

AD-A099 377 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG MS F/G 13/13
VALIDATION REPORT: COMPUTER PROGRAM FOR DESIGN AND ANALYSIS OF --ETC(U)
FEB 81 W A PRICE, R L HALL, R L MOSHER
UNCLASSIFIED WES-INSTRUCTION-K-81-3 NL

4 OF 4
AD
A099377

SUBJECT: EXHIBIT I SAMPLE FLOODWALL SLIDING ANALYSIS	COMPUTED BY: CHECKED BY:	DATE: DATE:	FILE NO. SHEET NO. 6

$$H_{R_\phi} = \left[14.338 + 0.9505\,k_A - 6.612\,c'\sqrt{k_A} - 0.2294\,k_P - 3.23411\,c'\sqrt{k_P}\right]\tan\phi' = 3.62$$

$$H_{R_c} = 15.86\,c' = 7.53$$

$$H_{P_\phi} = 0.5905\,k_P = 1.20$$

$$H_{P_c} = 8.399\,c'\sqrt{k_P} = 5.69$$

$$\Sigma R_W = H_{R_\phi} + H_{R_c} + H_{P_\phi} + H_{P_c} = 18.04$$

$$\Sigma R_W - \Sigma D_W = 18.04 - 6.08 = 11.96$$

Continue assuming safety factors and calculating $\Sigma R_W - \Sigma D_W$ until their difference is negligible. The system is then in equilibrium with the driving forces equal to the resisting forces and the safety factor which produces this condition is the safety factor against sliding.

SUBJECT EXHIBIT I

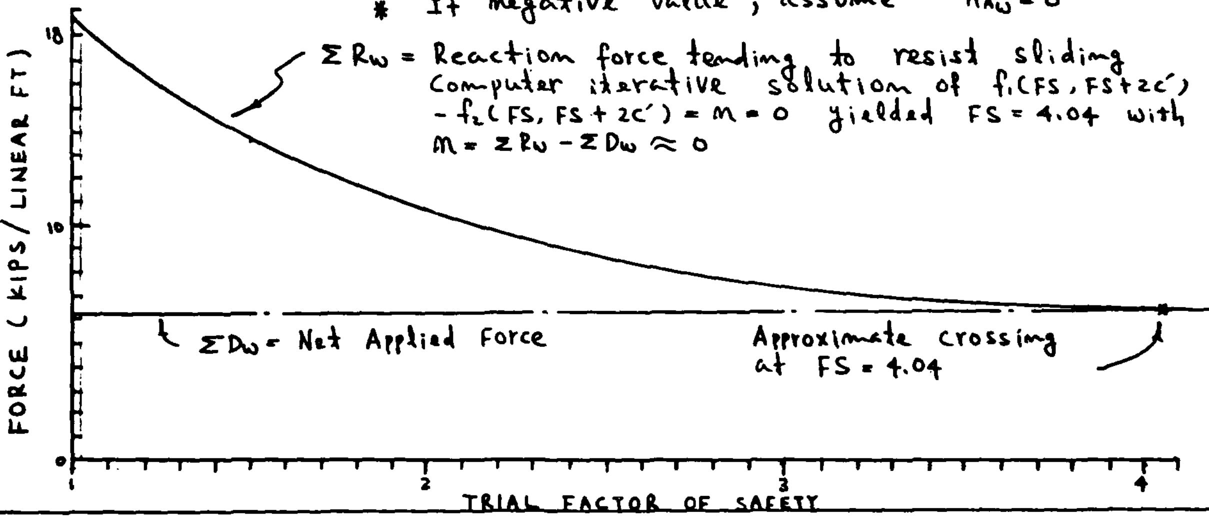
SAMPLE FLOODWALL SLIDING ANALYSIS

COMPUTED BY:	DATE:	FILE NO.
CHECKED BY:	DATE:	SHEET NO.

GRAPHICAL SOLUTION

FS	ϕ'	$\tan\phi'$	k_A	k_P	$\sqrt{k_P}$	c'	H_{A_W}*	ΣD_W	H_{R_ϕ}	H_{R_c}	H_{P_ϕ}	H_{P_c}	ΣR_W	$\Sigma R_W - \Sigma D_W$
1.0	20.0	0.364	0.490	2.04	1.43	0.475	-4.50	6.08	3.62	7.53	1.20	5.69	18.04	11.96
1.5	13.64	0.243	0.618	1.62	1.27	0.374	-3.52	6.08	2.69	5.93	0.95	3.79	13.56	7.48
2.0	10.31	0.182	0.696	1.44	1.20	0.304	-2.63	6.08	2.15	4.82	0.85	3.06	10.88	4.80
3.0	6.92	0.121	0.785	1.27	1.13	0.218	-1.37	6.08	1.54	3.45	0.75	2.06	7.80	1.72
4.0	5.20	0.091	0.834	1.20	1.10	0.168	-0.58	6.08	1.21	2.66	0.71	1.54	6.12	0.04
4.01	5.19	0.091	0.834	1.20	1.09	0.168	-0.57	6.08	1.20	2.66	0.71	1.54	6.11	0.03
4.02	5.17	0.091	0.835	1.20	1.09	0.167	-0.56	6.08	1.20	2.65	0.71	1.54	6.10	0.02
4.03	5.16	0.090	0.835	1.20	1.09	0.167	-0.56	6.08	1.20	2.65	0.71	1.53	6.09	0.01
4.04	5.15	0.090	0.835	1.20	1.09	0.166	-0.55	6.08	1.20	2.64	0.71	1.53	6.08	0.0
4.10	5.07	0.089	0.838	1.19	1.09	0.164	-0.51	6.08	1.18	2.60	0.71	1.51	6.00	-0.08

* If negative value ; assume $H_{A_W} = 0$



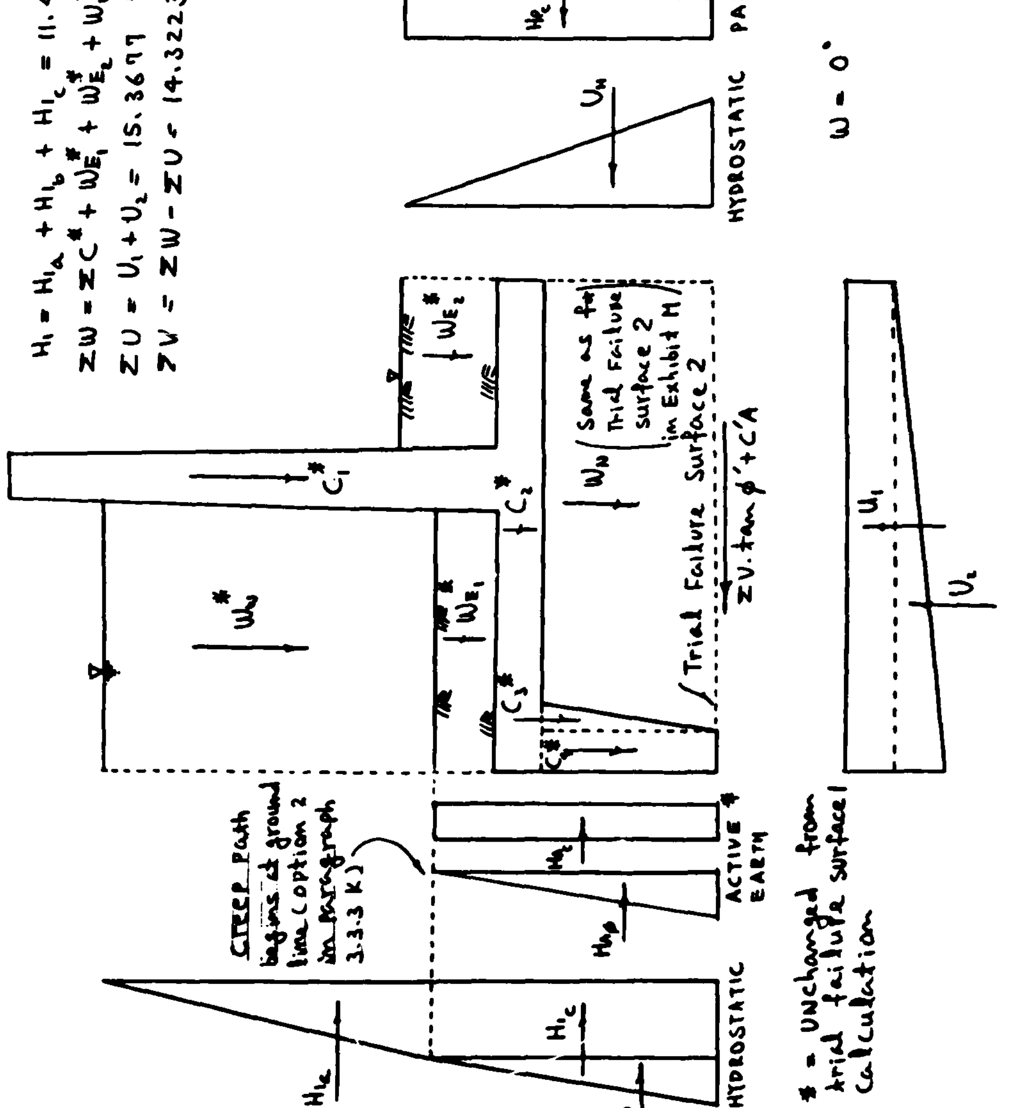
SUBJECT EXHIBIT I SAMPLE FLOODWALL SLIDING ANALYSIS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE:	SHEET NO. 8

$H_1 = H_{1a} + H_{1b} + H_{1c} = 11.422$ K/ft

$\Sigma W = \Sigma C^* + W_{E_1}^* + W_{E_2}^* + W_W^* + W_N = 29.69$ K/ft

$\Sigma U = U_1 + U_2 = 15.3677$ K/ft

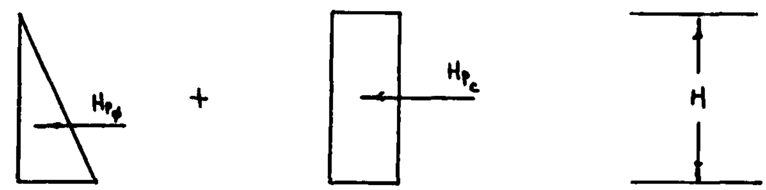
$\Sigma V = \Sigma W - \Sigma U = 14.3223$ K/ft



* = Unchanged from trial failure surface 1 calculation

SUBJECT EXHIBIT I SAMPLE FLOODWALL SLIDING ANALYSIS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE:	SHEET NO. 9

PASSIVE EARTH RESISTANCE AT TOE OF WALL



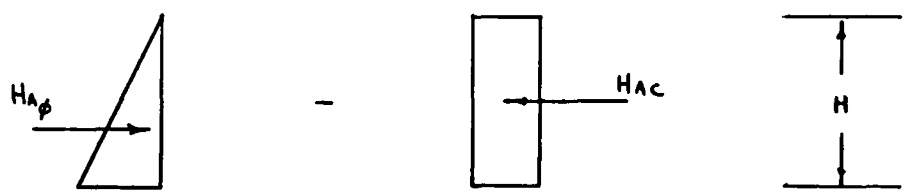
$$H_{P_\omega} = H_{P_\phi} + H_{P_c}$$

$$= \frac{1}{2} \gamma_b k_p H^2 + 2c' H \sqrt{k_p}$$

$$= \frac{1}{2} (0.125 - 0.0625)\, k_p\, (10.2)^2 + 2c' (10.2) \sqrt{k_p}$$

$$= 3.2513\ k_p + 20.4\ c' \sqrt{k_p}$$

ACTIVE EARTH DRIVING FORCE AT HEEL OF WALL



$$H_{A_\omega} = H_{A_\phi} - H_{A_c}$$

$$= \frac{1}{2} \gamma_b k_A \cdot H^2 - 2c' H \sqrt{k_A}$$

$$= \frac{1}{2} (0.125 - 0.0625)\, k_A\, (9.2)^2 - 2 \cdot c' (9.2) \sqrt{k_A}$$

$$= 2.645\ k_A - 18.4\ c' \sqrt{k_A}$$

SUBJECT EXHIBIT I SAMPLE FLOODWALL SLIDING ANALYSIS	COMPUTED BY: CHECKED BY:	DATE: DATE:	FILE NO. SHEET NO. 10

NET APPLIED FORCE TENDING TO INDUCE SLIDING

$\Sigma D_H = H_1 - U_H + H_A$ (See Sheet H-5 for H_1 and U_H values)

$= 11.422 - 4.117 + 2.645\, k_A - 18.4\, c'\sqrt{k_A}$

$= 7.305 + 2.645\, k_A - 18.4\, c'\sqrt{k_A}$

REACTION FORCES TENDING TO RESIST SLIDING

$\Sigma R_H = H_{R_W} + H_{P_W} = V_1 \tan\phi' + C' \cdot A + 3.2513\, k_p + 20.4\, c'\sqrt{k_p}$

$= 14.3223 \tan\phi' + 14.80\, c' + 3.2513\, k_p + 20.4 \cdot c'\sqrt{k_p}$

EQUILIBRIUM OF APPLIED AND REACTION FORCES
CONSIDERING TRIAL FAILURE SURFACE 2

WITH [$\Sigma D_H = f_1(FS, FS + 2c')$ AND $\Sigma R_H = f_2(FS, FS + 2c')$], the equilibrium relationship [$\Sigma D_H = \Sigma R_H$] becomes [$f_1(FS, FS + 2c') = f_2(FS, FS + 2c')$] which can be transposed to read [$f_1(FS, FS + 2c') - f_2(FS, FS + 2c') = 0$]

The computation of FS involves solving the expression

$$\Sigma D_H - \Sigma R_H = 0$$

$$f_1(FS, FS + 2c') - f_2(FS, FS + 2c') = 0$$

by an iterative procedure, either graphically (by hand) or analytically (on the computer). The procedure includes (1) assuming a trial value of FS, (2) calculating allowable values of ϕ' and c', (3) calculating k_A and k_p from ϕ', (4) substituting c', k_A, and k_p into ΣD_H and ΣR_H, and (5) either plotting $\Sigma D_H = f_1(FS, FS + 2c')$ and $\Sigma R_H = f_2(FS, FS + 2c')$ to get the point of intersection or solving for FS to make $\Sigma D_H - \Sigma R_H = 0$

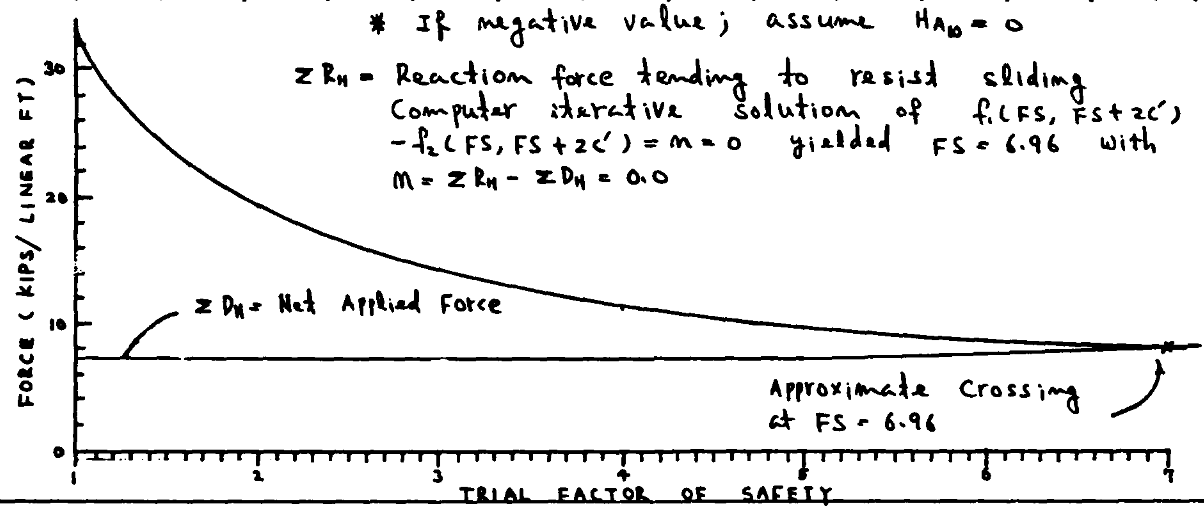
SUBJECT: EXHIBIT I SAMPLE FLOODWALL SLIDING ANALYSIS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE:	SHEET NO. 11

GRAPHICAL SOLUTION

FS	ϕ'	$\tan\phi'$	K_A	K_P	$\sqrt{K_P}$	c'	H_{A_W}*	ΣD_H	H_{R_ϕ}	H_{R_c}	H_{P_ϕ}	H_{P_c}	ΣR_H	$\Sigma R_H-\Sigma D_H$
1.0	20.0	0.364	0.490	2.04	1.43	0.475	-4.82	7.31	5.21	7.03	6.63	13.83	32.70	25.39
1.5	13.64	0.243	0.618	1.62	1.27	0.374	-3.77	7.31	3.48	5.53	5.26	7.69	23.96	16.65
2.0	10.31	0.182	0.696	1.44	1.20	0.304	-2.82	7.31	2.61	4.50	4.67	7.43	19.21	11.90
3.0	6.92	0.121	0.785	1.27	1.13	0.218	-1.47	7.31	1.74	3.22	4.14	5.01	14.11	6.80
4.0	5.20	0.091	0.834	1.20	1.10	0.168	-0.62	7.31	1.30	2.49	3.90	3.75	11.44	4.13
5.0	4.16	0.073	0.865	1.16	1.08	0.136	-0.04	7.31	1.04	2.02	3.76	2.99	9.81	2.50
6.0	3.47	0.061	0.886	1.13	1.06	0.114	0.36	7.67	0.87	1.69	3.67	2.43	8.71	1.04
6.9	3.02	0.053	0.900	1.11	1.05	0.100	0.63	7.94	0.76	1.48	3.61	2.15	8.00	0.06
6.92	3.01	0.053	0.900	1.11	1.05	0.100	0.64	7.95	0.75	1.48	3.61	2.14	7.98	0.03
6.94	3.00	0.052	0.900	1.11	1.05	0.099	0.65	7.95	0.75	1.47	3.61	2.14	7.97	0.02
6.96	2.99	0.052	0.901	1.11	1.05	0.099	0.65	7.96	0.75	1.47	3.61	2.13	7.96	0.0
6.97	2.99	0.052	0.901	1.11	1.05	0.099	0.65	7.96	0.75	1.47	3.61	2.13	7.95	-0.01
7.00	2.98	0.052	0.901	1.11	1.05	0.099	0.66	7.97	0.74	1.46	3.61	2.12	7.93	-0.04

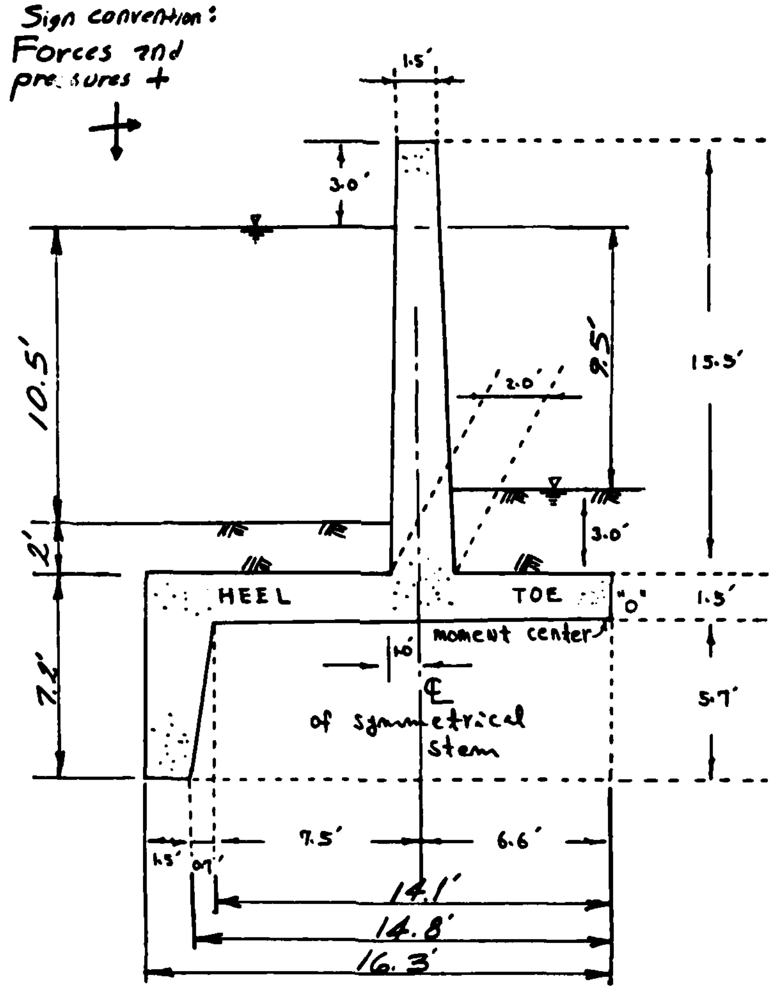
* If negative value; assume $H_{A_W} = 0$

ΣR_H = Reaction force tending to resist sliding
Computer iterative solution of $f_1(FS, FS+2c') - f_2(FS, FS+2c') = m = 0$ yielded $FS = 6.96$ with
$m = \Sigma R_H - \Sigma D_H = 0.0$



5-5-3 <u>Basic Notes for Load Cases 2 and 3 Overturning:</u>

SUBJECT: EXHIBIT K SAMPLE OVERTURNING ANALYSIS FOR FLOOD WALLS & RETAINING WALLS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE:	SHEET NO. 1

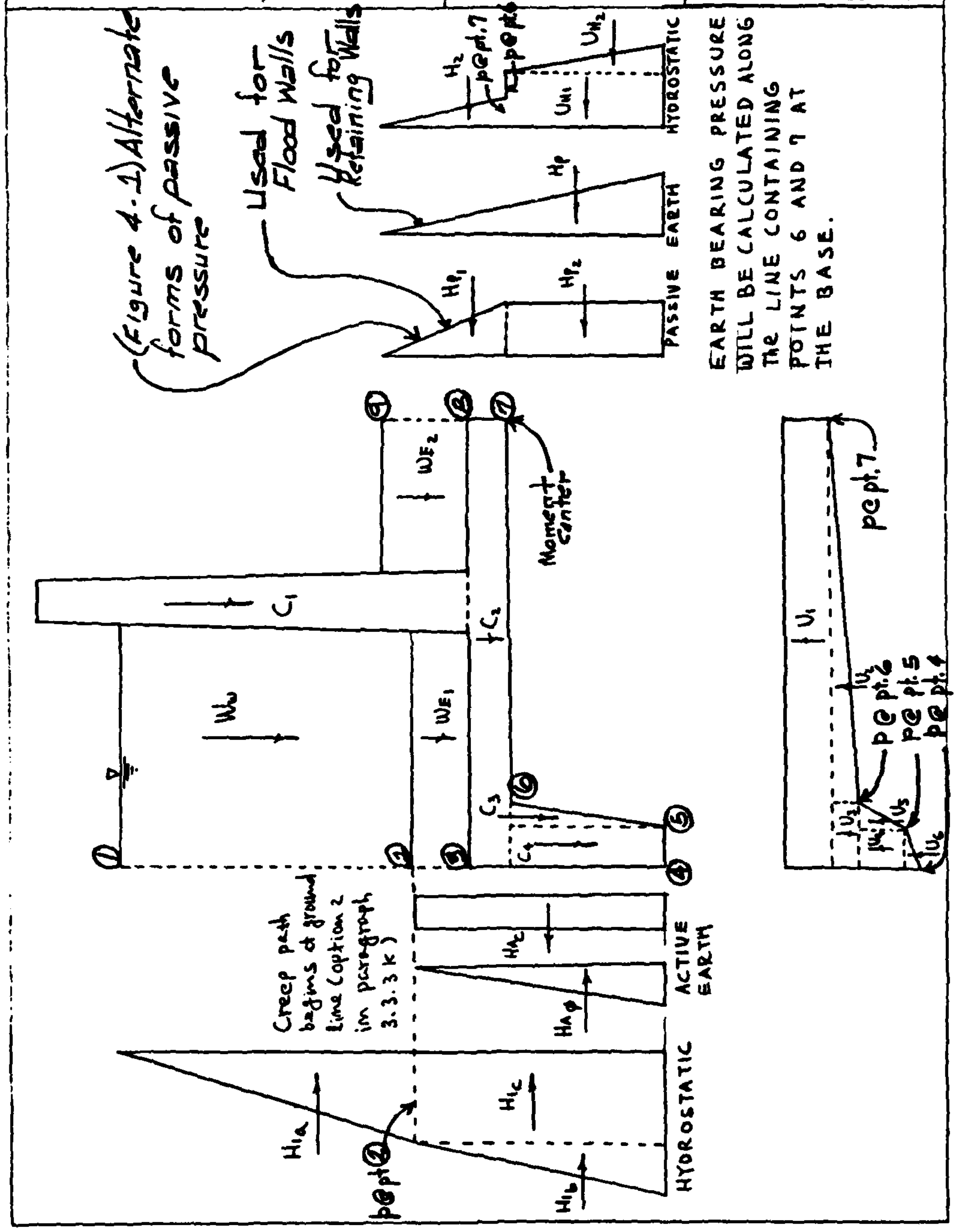


$\gamma_c = 150$ pcf $\qquad \phi = 20°$ $\qquad C = 0.35$ tsf $= 0.7$ ksf

$\gamma_w = 62.5$ pcf

$\gamma_{sat} = 125$ pcf $\qquad K_a = \tan^2(45° - \phi/2) \qquad K_p = \tan^2(45° + \phi/2)$

SUBJECT: EXHIBIT K SAMPLE OVERTURNING ANALYSIS FOR FLOOD WALLS & RETAINING WALLS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE:	SHEET NO. 2



SUBJECT EXHIBIT K SAMPLE OVERTURNING ANALYSIS FOR FLOOD WALLS & RETAINING WALLS	COMPUTED BY: CHECKED BY:	DATE: DATE:	FILE NO. SHEET NO. 3

CALCULATE LINE OF CREEP HYDROSTATIC PRESSURES

Note that these pressure will be different from the pressure shown in Exhibits H, I, and J because the assumed line of creep is in a different location (along the soil structure interface).

1. Lost head $= (\text{headwater} - \text{tailwater}) \dfrac{\text{total distance}}{\text{max. total distance}} = \dfrac{9.5 \ast \text{col } 2}{35.04}$

2. Potential head = (headwater - tailwater) - lost head
   = 9.5 - lost head
   = remaining seepage head.

3. Position head = Vertical distance to tail water, positive if below tailwater.

4. Uplift head = potential head + position head

5. Uplift pressure = uplift head x wt. of water

COLUMN	1	2	3	4	5	6	7
	creep path						
POINT	increment	total distance	lost head	Potential head	Position head	Uplift head	Uplift Pressure psf
1	0	0	0	9.50	-9.50	0	0
2	0	0	0	9.50	1.00	10.50	656
4	9.2	9.2	2.49	7.01	10.20	17.21	1075.4
5	1.5	10.7	2.90	6.60	10.20	16.80	1050
6	5.74	16.44	4.46	5.04	4.50	9.54	596.5
7	14.1	30.54	8.28	1.22	4.50	5.72	357.5
9	4.5	35.04	9.50	0	0	0	0

SUBJECT EXHIBIT K SAMPLE OVERTURNING ANALYSIS FOR FLOOD WALLS & RETAINING WALLS	COMPUTED BY	DATE	FILE NO.
	CHECKED BY	DATE	SHEET NO. 4

CALCULATE ACTIVE EARTH PRESSURE

$K_{A\phi} = \tan^2(45° - \phi/2) = \tan^2(45° - 20°/2) = 0.490$

$P_A = \gamma H K_A - 2C\sqrt{K_A} = (125 - 62.5)(9.2)(0.49) - 2(700)(\sqrt{0.49})$

$= 281.75 - 980 = -698.25$

The soil will not pull on the wall in the active state; therefore, let $P_A = 0$.

SUBJECT: EXHIBIT K — SAMPLE OVERTURNING ANALYSIS FOR FLOOD WALLS & RETAINING WALLS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE:	SHEET NO. 5

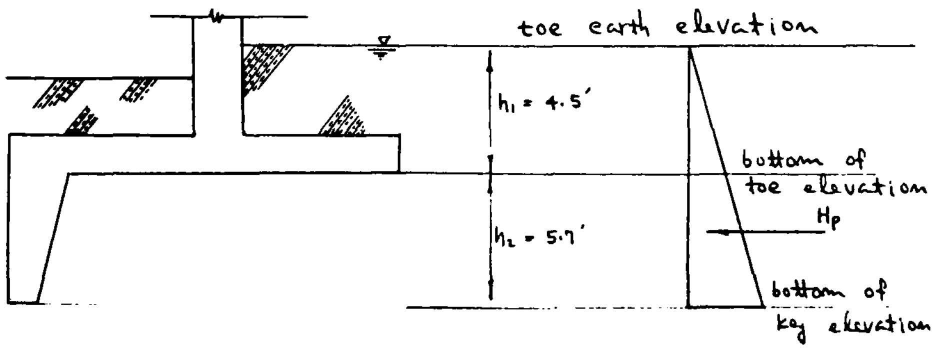
FORCE AND MOMENT SUMMARY

Item	FACTORS (ft, lb)	FORCE →	FORCE N ↓	MOMENT ARM, FT	MOMENT +"O"
C_1	$\frac{1}{2}(1.5+2.0)(15.5)(150)$		4069	6.6	26854
C_2	$1.5(16.3)(150)$		3668	8.15	29890
C_3	$\frac{1}{2}(0.7)(5.7)(150)$		299	14.57	4360
C_4	$1.5(5.7)(150)$		1283	15.55	19943
CONCRETE SUBTOTALS			9319	8.70	81047
W_{E1}	$2(125)\frac{8.7+8.732}{2}$		2179	11.942	26022
W_{E2}	$3(125)\frac{5.6+5.648}{2}$		2109	2.812	5931
W_w	$10.5(8.732)(62.5)$		5730	11.93	68382
above E_1	$10.5(0.169)(\frac{1}{2})(62.5)$		55	7.512	413
H_A	$281.75(9.2)(\frac{1}{2})$	1296 } 0		2.633	3412 } 0
	$-980.0(9.2)$	-9016		1.100	-9919.6
H_{1A}	$656(10.5)(\frac{1}{2})$	3444		-7.0	-24108
H_{1B}	$(1075.4-656)(9.2)(\frac{1}{2})$	1929		2.633	5080
H_{1C}	$656(9.2)$	6035		1.1	6639
SUBTOTAL H_1		11408		-1.086	-12389
H_2	$357.5(4.5)(\frac{1}{2})$	-804		-1.5	1207
U_{H1}	$596.5(5.7)$	-3400		2.85	-9690
U_{H2}	$(1050-596.5)(5.7)(\frac{1}{2})$	-1293		3.80	-4911
SUBTOTAL U_H		-4693		3.11	-14601
U_1	$357.5(16.3)$		-5827	8.15	-47492
U_2	$(596.5-357.5)(14.1)(\frac{1}{2})$		-1685	9.4	-15839
U_3	$239(2.2)$		-526	15.2	-7992
U_4	$(1050-596.5)(1.5)$		-680	15.55	-10578
U_5	$453.5(0.7)(\frac{1}{2})$		-159	14.567	-2312
U_6	$(1075.4-1050)(1.5)(\frac{1}{2})$		-19	15.8	-301
SUBTOTAL $U_1+\cdots+U_6$			-8896	9.50	-84514
SUBTOTAL F → w/o passive Resistance		5911	10496		91,498

5-5-4 Load Case 2 Overturning:

SUBJECT EXHIBIT K SAMPLE OVERTURNING ANALYSIS FOR RETAINING WALL	COMPUTED BY / CHECKED BY	DATE / DATE	FILE NO. / SHEET NO 14

RETAINING WALL CALCULATION OF HORIZONTAL REACTION FORCE



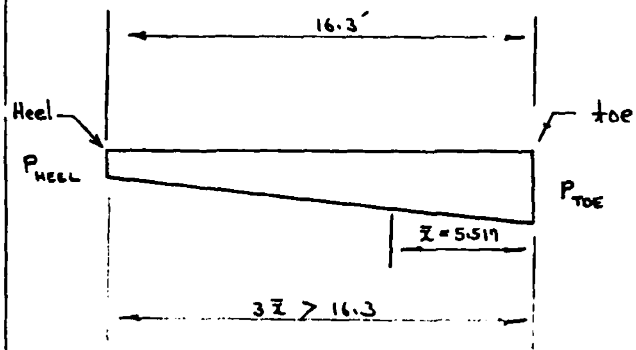
$H_p = \frac{1}{2}(h_1 + h_2) P_p$

$5911 = \frac{1}{2}(10.2) P_p$ $\qquad P_p = 1159.02$ #/ft.

Get N:

Factors	Force →	Force ↓ lb/ft	Arm	MOMENT ↻+ about point "o"
Subtotals from page K5	5,911	10,496		71,498
Horizontal reaction force	-5,911		2.3	-13,595.3
Totals	0	10,496		57902.7

SUBJECT: EXHIBIT K SAMPLE OVERTURNING ANALYSIS FOR RETAINING WALLS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE:	SHEET NO. 15



Resultant vertical force is located $\frac{57902.7}{10496} = 5.517'$ from the toe

Resultant ratio $= \frac{5.517}{16.3} = 0.3385 > 0.333$ inside the kern

<u>Base Pressure</u>

$$P_{\substack{TOE\\OR\\HEEL}} = \frac{P}{A} \pm \frac{Mc}{I} = \frac{10,496}{16.3} \pm \frac{(10,496)\left[\frac{16.3}{2} - 5.519\right]\left[\frac{16.3}{2}\right]}{\frac{(1)(16.3)^3}{12}}$$

$= 643.93 \pm 624.10$

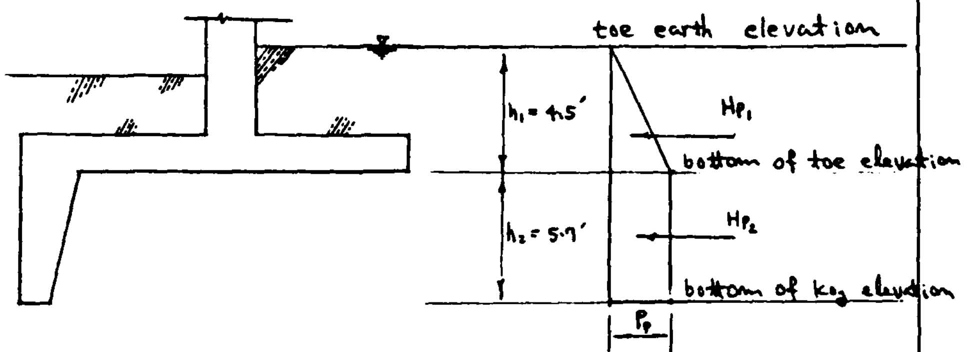
$= 1268.03$ PSF TOE

19.83 PSF HEEL

5-5-5 Load Case 3 Overturning:

SUBJECT: EXHIBIT K SAMPLE OVERTURNING ANALYSIS FOR FLOOD WALLS	COMPUTED BY: CHECKED BY:	DATE: DATE:	FILE NO. SHEET NO. 12

FLOOD WALL CALCULATION OF HORIZONTAL REACTION FORCE



$$H_p = H_{P_1} + H_{P_2} = \tfrac{1}{2} h_1 P_p + h_2 P_p$$

$$5911 = (\tfrac{1}{2})(4.5) P_p + 5.7\, P_p$$

$$P_p = \frac{5911}{(\frac{1}{2})(4.5) + 5.7} = 743.52 \ \#/ft.$$

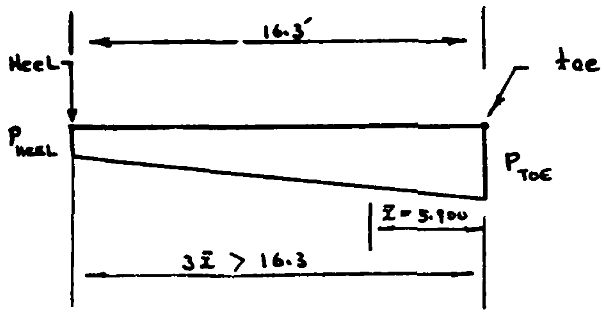
$$H_{P_1} = \tfrac{1}{2}(4.5)(743.52) = 1673^{\#}$$

$$H_{P_2} = (5.7)(743.52) = 4238^{\#}$$

Get N:

Factors	Force $\rightarrow$	Force $\downarrow$ lb/ft	Arm	Moment $\curvearrowleft^{+}$ about point "O"
Subtotals from pg Q-5	5,911	10,496		71,498
Horizontal reaction force	-1,673		-1.5	2,509.5
	-4,238		2.85	-12,078.3
Totals	0	10,496		61,929.2

SUBJECT EXHIBIT K SAMPLE OVERTURNING ANALYSIS FOR FLOOD WALLS	COMPUTED BY:	DATE:	FILE NO.
	CHECKED BY:	DATE-	SHEET NO. 13



Resultant vertical force is located $\dfrac{61929.2}{10496} = 5.900'$ from the toe

Resultant ratio $= \dfrac{5.900}{16.3} = 0.3620 > 0.333$
INSIDE the kern

BASE PRESSURE

$$P_{\substack{TOE\\OR\\HEEL}} = \frac{P}{A} \pm \frac{MC}{I} = \frac{10,496}{16.3} \pm \frac{(10,496)\left[\frac{16.3}{2} - 5.9\right]\left[\frac{16.3}{2}\right]}{\frac{(1)(16.3)^3}{12}}$$

$= 643.93 \pm 533.31$

$= 1177.24$ PSF TOE

110.62 PSF HEEL

5-6 COMPARISONS OF RESULTS

5-6-1 Sliding Factors of Safety:

Load Case	Program	Exhibit	Difference	Percent of Exhibit
2	5.52 (shear friction)	5.42	0.10	1.8
3	4.01 (allowable strength)	4.04	-0.03	0.7

5-6-2 Load Case 2 Overturning Stability:

Item	Program	Exhibit	Difference	Percent of Exhibit
Resultant ratio	0.3382	0.3385	-0.0003	0.89
Bearing pressure				
At toe	1259.83	1268.03	-8.2	0.65
At heel	18.48	19.82	-1.34	6.76
Maximum passive pressure	1153.1	1159.02	-5.92	0.51

5-6-3 Load Case 3 Overturning Stability:

Item	Program	Exhibit	Difference	Percent of Exhibit
Resultant ratio	0.3618	0.3620	-0.0002	0.06
Bearing pressure				
At toe	1169.19	1177.24	-8.05	0.68
At heel	109.12	110.62	-1.5	1.36
Maximum passive pressure	741.21	743.52	-2.31	0.31

CHAPTER 6: PROBLEM V5

6-1 <u>DESCRIPTION OF PROBLEM.</u> This problem uses load case 1 of problem V1 and adds a new load case 2 like load case 1 except that data list SOLP is used to change IFWOC from its default value of 2 (Coulomb) to 1 (wedge).

6-2 <u>DATA PREPARATION.</u> Start with date file EX1DATA from the Basic User's Guide, and add a new data list. Do this interactively. Run module SP for pressures on the stem, not module FA. This should give the same forces and elevations for both load cases.

<u>DATA FILE:</u>

```
*LIST EX1DATA

1000 INIT
1010 1
1020 P
1030 N
1040 NAME  EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
2000 SSHC 0  87.29  6.0
2010 SST   0  74.0  100.0
3000 SPE3 18.0 0.0 120.0 18.0 0.0 3000.0 4600.0 3000.0 4600.0 60.0
3010 SPH1  0  30.0  0.0  120.0  C  0.0  C  C
3020 SPT7  0  30.0  0.0  120.0
4000 WLA   87.5  2.0  C  C
4010 WLAB  11.0  11.0  12.0  0.0
4020 WLAH  18.0  S  18.0
4030 WLAS  12.0  0.0  18.0  0.0  0.0  C
4040 WLAT  72.5  18.0  100.0  0.0  100.0
5000 STLS  1  0.79  1  0.79
5010 STLB  1  1  0.79  1  0.79
5020 STLB 13  1  0.79  1  0.79
6000 UPDATE
```

6-3 TIME-SHARING TERMINAL INPUT/OUTPUT:

```
@FORTRAN
@RUN WESLIB/TWDA,R

        09/17/80    13.666

:

PROGRAM TWDA -- 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
       REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EXV5UPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?W.A.PRICE
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?EX1DATA
PROCESSING DATA FILE...

::
:: UPDATE FILE RESET
::

::
:: DATA FILE PROCESSING DONE
::
:: RETURN TO INTERACTIVE INPUT
::

COMMAND
?SOLP 2 1 C

NOT ENOUGH VALUES ENTERED IN DATA LIST - SOLP
TRAILING VALUES SET TO 'C'

COMMAND
?CASE 2 1 2

COMMAND
?RUN SP


         HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  1
         FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)
```

```
FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE =     4220.41 LBS/HORIZ FT
ACTING AT ELEVATION     78.49

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE =         0.    LBS/HORIZ FT
ACTING AT ELEVATION       0.


HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  2
FOR WEDGE ANALYSIS IN SP (FACE OF STEM).


FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE =     4212.99 LBS/HORIZ FT
ACTING AT ELEVATION     78.50

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE =         0.    LBS/HORIZ FT
ACTING AT ELEVATION       0.

::
:: UPDATE FILE RESET
::


::
:: COMMAND-DATA PHASE ENTERED
::


COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?0
ENTER NAME FOR NEW PERMANENT FILE TO HOLD THE REPORT FILE (8 CHAR. MAX.)
?EXV5REPO
REPORT FILE SAVED AS FILE NAMED EXV5REPO (UNLESS <50> MESSAGE PRINTED ABOVE)


YOUR UPDATE FILE FOR FUTURE RESTART IS NAMED EXV5UPD
STOP     OK (RELEASE UNNEEDED FILES)

*
```

6-4 REPORT FILE PRINTOUT:

```
13:40:56 ON  9/17/80


NOTES TO EXPLAIN SPECIAL PRINTOUT THAT MIGHT BE IN THIS FILE--

THE VALUE "-.1234E+31" IS USED TO DENOTE AN  UNDEFINED ITEM;
THE VALUE "-.1432E+31" MEANS THAT THE DEFAULT VALUE WAS REQUESTED.

A "MEMORY FAULT AT ..." MESSAGE PROBABLY MEANS THAT NEEDED DATA IS UNDEFINED.


END OF NOTES.

COMMAND ENTERED:
INIT

*-- ALL DATA RESET FOR FRESH START --*

COMMAND ENTERED:
R

COMMAND ENTERED:
N
```

```
13 41 23 ON 9/17/80

WALL DECLARED TO BE A NON-HYDRAULIC RETAINING WALL

COMMAND ENTERED
NAME EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS

COMMAND ENTERED
SOIP 0 87 29 6 0

COMMAND ENTERED
SSI 0 24 0 100 0

COMMAND ENTERED
SPLS 18 0 0 0 120 0 18 0 0 0 3000.0 4600.0 3000.0 4600.0 60.0

COMMAND ENTERED
SPH1 0 30 0 0.0 120 0 0 0 0 0 0

COMMAND ENTERED
SPL2 0 30 0 0.0 120.0

COMMAND ENTERED
WLA 82 5 2 0 0 0

COMMAND ENTERED
WLAB 11 0 11 0 12 0 0 0

COMMAND ENTERED
WLAH 18 0 5 18 0

COMMAND ENTERED
WLAS 12 0 0 0 18 0 0 0 0 0 0

COMMAND ENTERED
WLAT 22 5 18 0 100 0 0.0 100 0

COMMAND ENTERED
SIFS 1 0 29 1 0 29

COMMAND ENTERED
SIFB 1 1 0 29 1 0 29

COMMAND ENTERED
SIFB 1S 1 0 29 1 0 29

COMMAND ENTERED
DEBATE
```

```
*
* UPDATE FILE RESET
*


COMMAND ENTERED:


COMMAND ENTERED:
SOLP 2 1 C

NOT ENOUGH VALUES ENTERED IN DATA LIST - SOLP
TRAILING VALUES SET TO 'C'

COMMAND ENTERED:
CASE 2 1 2

COMMAND ENTERED:
RUN SP
```

```
EXAMPLE 1 -  BASIC RETAINING WALL ANALYSIS
        13:49:57 ON  9/17/80

*
* BEGIN BASIC STABILITY DATA CHECK
*

DEFAULT VALUE OF    62.50000     USED FOR GAMAW      (LOAD CASE  1)
DEFAULT VALUE OF    150.0000     USED FOR GAMAC      (LOAD CASE  1)
DEFAULT VALUE OF    1.000000     USED FOR ESS        (LOAD CASE  1)
DEFAULT VALUE OF    2.000000     USED FOR EXW        (LOAD CASE  1)
DEFAULT VALUE OF   0.            USED FOR UCEXS3     (LOAD CASE  1)
DEFAULT VALUE OF   0.            USED FOR UCEXS4     (LOAD CASE  1)
DEFAULT VALUE OF   0.            USED FOR UCEXS5     (LOAD CASE  1)
DEFAULT VALUE OF   0.            USED FOR UCBFS1     (LOAD CASE  1)
DEFAULT VALUE OF   0.            USED FOR UCBFS2     (LOAD CASE  1)
DEFAULT VALUE OF   0.            USED FOR UCBFF7     (LOAD CASE  1)
DEFAULT VALUE OF   0.            USED FOR UCBFS7     (LOAD CASE  1)
DEFAULT VALUE OF   0.            USED FOR UCBFS6     (LOAD CASE  1)
DEFAULT VALUE OF    1.000000     USED FOR UCWS       (LOAD CASE  1)
DEFAULT VALUE OF    1.000000     USED FOR UCWR       (LOAD CASE  1)
DEFAULT VALUE OF    1.000000     USED FOR UCWK       (LOAD CASE  1)
DEFAULT VALUE OF           2     USED FOR IFWOC      (LOAD CASE  1)
DEFAULT VALUE OF           1     USED FOR IFSOM      (LOAD CASE  1)
DEFAULT VALUE OF    1.000000     USED FOR CFMA       (LOAD CASE  1)
DEFAULT VALUE OF   0.3333333     USED FOR RRMIN      (LOAD CASE  1)
DEFAULT VALUE OF           2     USED FOR KRACK      (LOAD CASE  1)
DEFAULT VALUE OF    2.000000     USED FOR FSMIN      (LOAD CASE  1)
DEFAULT VALUE OF           1     USED FOR NSLIDE     (LOAD CASE  1)
DEFAULT VALUE OF   0.            USED FOR HGSW       (LOAD CASE  1)
DEFAULT VALUE OF           1     USED FOR IFSOM      (LOAD CASE  2)
DEFAULT VALUE OF    1.000000     USED FOR CFMA       (LOAD CASE  2)
DEFAULT VALUE OF   0.3333333     USED FOR RRMIN      (LOAD CASE  2)
DEFAULT VALUE OF           2     USED FOR KRACK      (LOAD CASE  2)
DEFAULT VALUE OF    2.000000     USED FOR FSMIN      (LOAD CASE  2)
DEFAULT VALUE OF           1     USED FOR NSLIDE     (LOAD CASE  2)
DEFAULT VALUE OF   0.            USED FOR HGSW       (LOAD CASE  2)
DEFAULT VALUE OF    100.0000     USED FOR HSS5H      (LOAD CASE  1)
DEFAULT VALUE OF   0.            USED FOR DSS5H      (LOAD CASE  1)
```

```
EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
        13:49:57 ON  9/17/80


*
* BEGIN PART 2 OF STABILITY DATA CHECK
*


EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
        13:49:57 ON  9/17/80


*
* BEGIN MODULE FA
*


VARIABLE HEELW CALCULATED        7.50 (BW-TW2-TSTB)
VARIABLE HSBPB CALCULATED OR DEFAULTED TO CLOSE COORDINATES,
        HSBPB =  0.444444 IN/FT.


                COORDINATES OF CORNERS OF WALL CROSS-SECTION

        X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
        Y-COORDINATES ARE ELEVATIONS

   PT.     X          Y                  DESCRIPTION OF POINT
   ---  --------  ----------  ----------------------------------------
    1    0.         87.5000   BASIC WORKING POINT = TOE-SIDE OF STEM TOP
    2    0.         74.0000   BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
    3    0.         74.0000   BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
    4   -2.0000     74.0000   TOP OF TOEHT = AT OUTER END OF TW2
    5   -2.0000     72.5000   TOE END OF BASE = AT BTE1
   10    9.0000     72.5000   HEEL END OF BASE
   11    9.0000     74.0000   TOP OF HEELT2 = TOP OF OUTER END OF HEEL
   12    1.5000     74.0000   BOTTOM OF HEEL-SIDE FACE OF STEM
   13    1.0000     87.5000   BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
   14    1.0000     87.5000   TOP OF HEEL-SIDE FACE OF STEM
```

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
13:49:58 ON 9/17/80

*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:

BACKFILL LAYER	KA VALUE
1	0.3879

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 1
FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)

OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
87.457	7.7689	0.
86.457	46.614	0.
85.457	93.227	0.
84.457	139.84	0.
83.457	186.45	0.
82.457	233.07	0.
81.457	279.68	0.
80.457	326.30	0.
79.457	372.91	0.
78.457	419.52	0.
77.457	466.14	0.
76.457	512.75	0.
75.457	559.36	0.
74.457	435.19	0.
74.000	141.59	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 4220.41 LBS/HORIZ FT
ACTING AT ELEVATION 78.49

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 4220.41 LBS/HORIZ FT
ACTING AT ELEVATION 78.49

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 2
FOR WEDGE ANALYSIS IN SP (FACE OF STEM).

OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR WEDGE ANALYSIS

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
86.938	24.929	0.
85.903	74.787	0.
84.868	124.64	0.
83.833	174.50	0.
82.798	224.36	0.
81.763	274.22	0.
80.728	324.08	0.
79.693	373.93	0.
78.658	423.79	0.
77.623	473.65	0.
76.588	523.51	0.
75.553	573.37	0.
74.518	623.22	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE = 4212.99 LBS/HORIZ FT
ACTING AT ELEVATION 78.50

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE = 0. LBS/HORIZ FT
ACTING AT ELEVATION 0.

*
* EXIT MODULE EA
*

*
* UPDATE FILE RESET
*

COMMAND ENTERED:
RUN SA

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
13:51:14 ON 9/17/80

*
* BEGIN PART 2 OF STABILITY DATA CHECK
*

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
13:51:14 ON 9/17/80

*
* BEGIN MODULE FA
*

VARIABLE HEELW CALCULATED 7.50 (BW-TW2-TSTB)

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT	X	Y	DESCRIPTION OF POINT
1	0.	87.5000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	0.	74.0000	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	0	74.0000	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-2.0000	74.0000	TOP OF TOEHT = AT OUTER END OF TW2
5	-2.0000	72.5000	TOE END OF BASE = AT BTE1
10	9.0000	72.5000	HEEL END OF BASE
11	9.0000	74.0000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	1.5000	74.0000	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.0000	87.5000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.0000	87.5000	TOP OF HEEL-SIDE FACE OF STEM

EXAMPLE 1 -- BASIC RETAINING WALL ANALYSIS
13:51:15 ON 9/17/80

*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*

COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:

BACKFILL LAYER	KA VALUE
1	0.3711

HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE 1
FOR CLASSIC(COULOMB) ANALYSIS IN SA (END OF HEEL)

OUTPUT OF ARRAYS H, EH, AND YH IN MODULE SA FOR CLASSIC ANALYSIS.

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
88.790	7.4212	0.
87.790	44.527	0.
86.790	89.055	0.
85.790	133.58	0.
84.790	178.11	0.
83.790	222.64	0.
82.790	267.16	0.
81.790	311.69	0.
80.790	356.22	0.
79.790	400.75	0.
78.790	445.27	0.
77.790	489.80	0.
76.790	534.33	0.
75.790	578.85	0.
74.790	623.38	0.
73.790	667.91	0.
72.790	452.72	0.
72.500	104.55	0.

FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

```
RESULTANT HORIZONTAL STATIC ACTIVE FORCE =     5907.97 LBS/HORIZ FT
ACTING AT ELEVATION     77.93

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE =        0.    LBS/HORIZ FT
ACTING AT ELEVATION      0.


HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  2
FOR WEDGE ANALYSIS IN SA (END OF HEEL).


OUTPUT OF ARRAYS H, EH, AND YH IN MODULE SA FOR WEDGE ANALYSIS.
```

ELEVATION (FT)	INCREMENTAL HORIZONTAL STATIC FORCE (LBS/FT)	INCREMENTAL HORIZONTAL EARTHQUAKE FORCE (LBS/FT)
88.310	20.450	0.
87.352	61.349	0.
86.393	102.25	0.
85.435	143.15	0.
84.477	184.[illegible]	0.
83.519	224.95	0.
82.561	265.84	0.
81.603	306.74	0.
80.644	347.64	0.
79.686	388.54	0.
78.728	429.44	0.
77.770	470.34	0.
76.812	511.24	0.
75.854	552.14	0.
74.895	593.04	0.
73.937	633.94	0.
72.979	1350.3	0.

```
FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

RESULTANT HORIZONTAL STATIC ACTIVE FORCE =     6585.39 LBS/HORIZ FT
ACTING AT ELEVATION     77.43

RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
DUE TO EARTHQUAKE =        0.    LBS/HORIZ FT
ACTING AT ELEVATION      0.

#
# UPDATE FILE RESET
#

COMMAND ENTERED:
END
$       ENDJOB

end of file
```

6-5 COMPARISONS OF RESULTS. Since the Coulomb active earth pressure calculations of problem V1 were verified with that problem, verification of the wedge method requires only showing that the two procedures yield the same answers:

Coulomb	Wedge	Difference	Percent of Coulomb
4220.41 lb/ft	4212.99 lb/ft	7.42	0.18
At el 78.49	At el 78.50	0.01	0.013

CHAPTER 7: PROBLEM V6

7-1 DESCRIPTION OF PROBLEM. This problem uses load case 2 of problem V2 (water 3 ft down from top of stem) and adds an earthquake acceleration factor of 0.2. Load case 1 is deleted.

7-2 DATA PREPATATION:

REST EXV2UPD (restore problem V2)

CASE 1 2 (one load case, number 2 only)

List Name	LC	IFWOC	NODE	IFSOM	NPPD	RKH	RKV	CFMA
SOLP	2	S	S	S	S	0.2	0.0	S

7-3 TIME-SHARING TERMINAL INPUT/OUTPUT:

```
*FORTRAN
*RUN WESLIB/TWDA,R

        09/17/80    14.716

:

PROGRAM TWDA -- 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
       REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EXV6UPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?W.A.PRICE
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?


IS THIS AN INITIAL RUN OR A RESTART OF A PREVIOUS RUN?
ENTER 'INIT' OR 'REST'

COMMAND
?REST EXV2UPD

*- ALL DATA RESET FOR FRESH START -*
*- COMMON DATA RESET FROM RESTART FILE EXV2UPD , UPDATE FILE RESET -*

COMMAND
?CASE  1  2

COMMAND
?SOLP  2  S  S  S  S  0.2  0.0  S

COMMAND
?NAME  RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE

COMMAND
?UPDATE

*
* UPDATE FILE RESET
*
```

```
COMMAND
?TRCE 3

COMMAND
?RUN FA

          14:49:25 ON  9/17/80

          14:49:25 ON  9/17/80

          14:49:25 ON  9/17/80

          14:49:27 ON  9/17/80

THE RESULTANT RATIO =       0.2303, FOR LOAD CASE  2

          14:49:29 ON  9/17/80

FINAL FACTOR OF SAFETY AGAINST SLIDING =     1.13, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C      TANPHI'=TANPHI/FS

          14:49:47 ON  9/17/80

          14:49:48 ON  9/17/80

TOTAL CONCRETE VOLUME =         81.82 (CU FT / LF), FOR LOAD CASE  2

          14:49:49 ON  9/17/80

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
         (MAKE HARD COPY BEFORE CARRIAGE RETURN)
   OR 0 TO OMIT THE PLOTS
?0

:
: UPDATE FILE RESET
:

:
: COMMAND-DATA PHASE ENTERED
:

COMMAND
?RUN WA
:
: BEGIN MODULE WA
:

ENTER 1 TO SEE A TABLE OF X AND Y CORNER COORDINATES
   OR 0 TO CONTINUE WITHOUT SEEING THE TABLE
?0
```

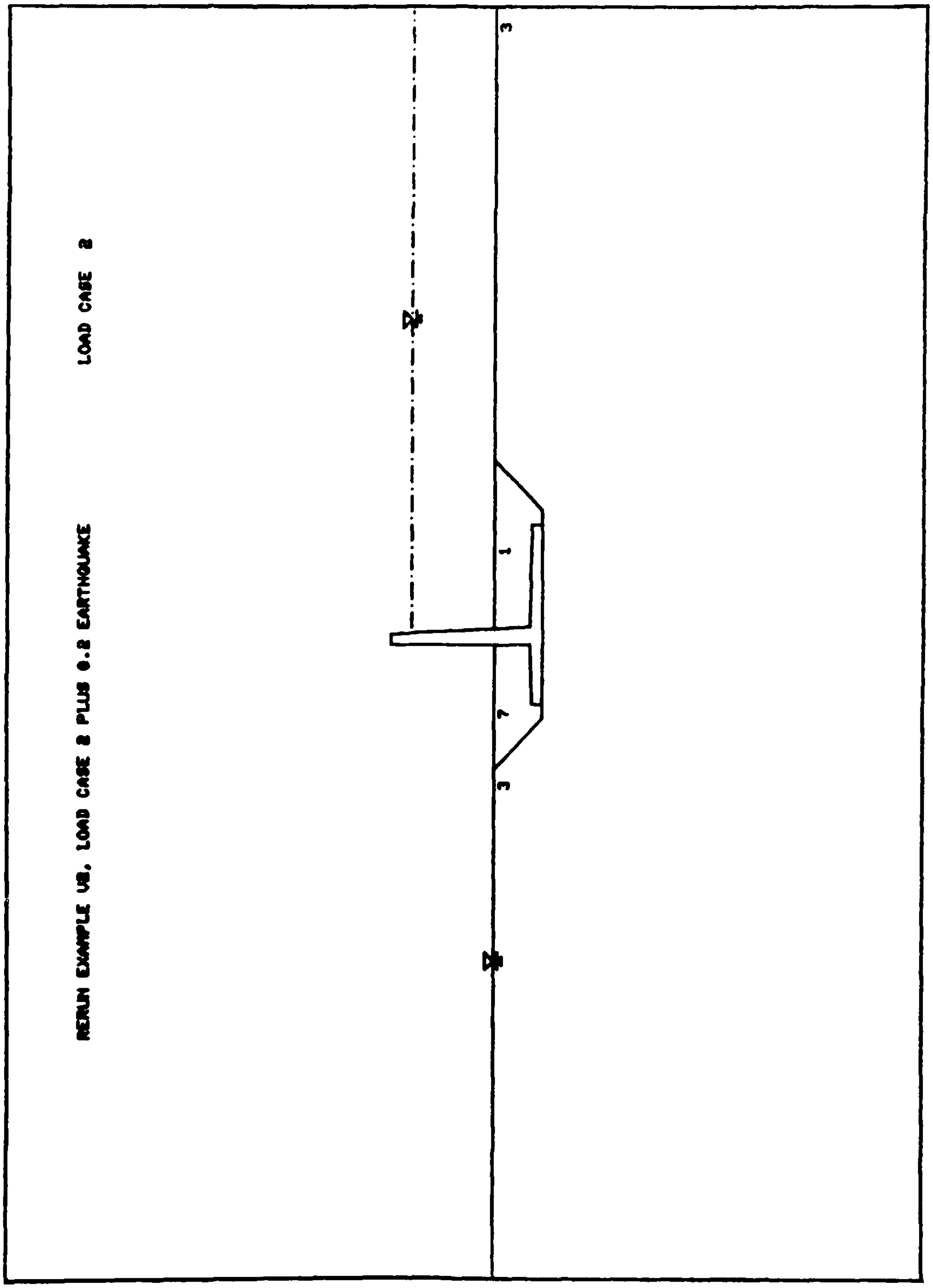
```
          14:51:45 ON  9/17/80

*
* BEGIN STRESS ANALYSIS
*

ENTER T TO GET THE ANALYSIS RESULTS AT YOUR TERMINAL
   OR R TO PUT THEM IN THE REPORT FILE
   OR B TO PUT THEM BOTH PLACES
?B

ENTER THE LOAD CASE NUMBER YOU WANT ANALYZED
   OR A ZERO FOR ALL LOAD CASES IN DATA LIST "CASE"
   OR * TO STOP THE MODULE
?0

          14:52:20 ON  9/17/80

*
* BEGIN STEM STRESS ANALYSIS
*

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *):
?C


SHEAR AT A DISTANCE D ABOVE THE BASE--

--- SHEAR ANALYSIS AT ELEVATION    46.93  (+ V FROM TOP PUSHED TOWARD TOE) ---
LOAD       V           N (COMP +)        M          UNIT SHEAR   ALLOWABLE  ACI318-77
CASE  LB / SLICE   LB / SLICE  LB-FT/SLICE  STRESS  PSI  UNIT STRESS PROVISION
----  ----------   ----------  -----------  -----------  ----------- ---------
 2     7371.4       5276.1       51391.        24.367       60.803    B.7.4.5

MOMENT AT THE BASE--

FLEXURE ANALYSIS AT ELEVATION    44.84 (+ M = TENSION AT HEEL)
LOAD  N (COMP=+)         M          FC      FS
CASE  LB / SLICE   LB-FT/SLICE    PSI      PSI
----  ----------   -----------   -----   ------
 2       6040.         66103.     791.   15016.

STEM ANALYSIS COMPLETE TO BASE

SELECT TYPE C, S, OR F ANALYSIS FOR STEM (OR ?, N, R, OR *):
?N

          14:53:45 ON  9/17/80

*
* BEGIN TOE STRESS ANALYSIS
*

SELECT TYPE C, S, OR F ANALYSIS FOR TOE  (OR ?, N, R, OR *):
?C
```

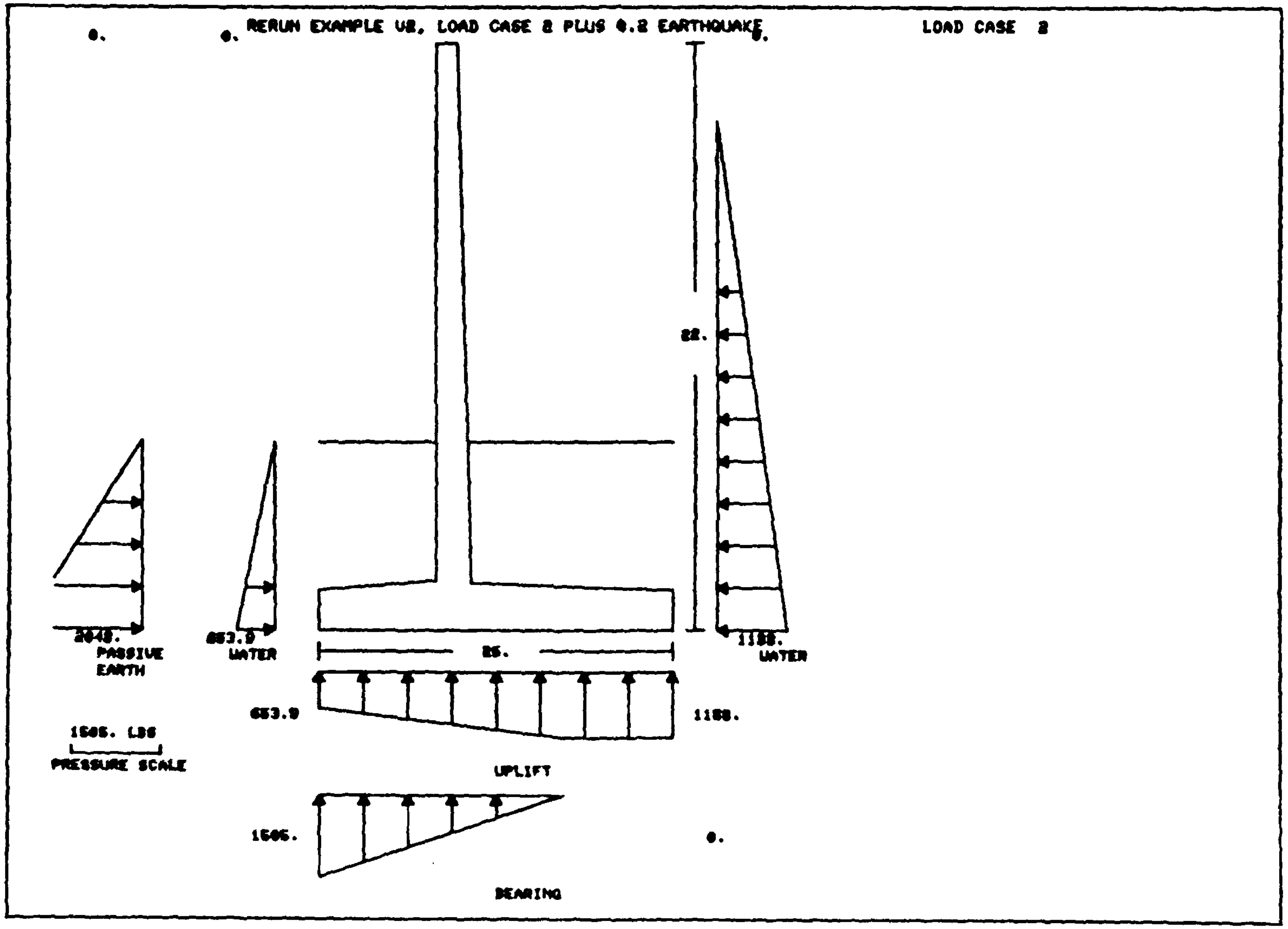
```
SHEAR AT A DISTANCE D FROM THE STEM--

--- SHEAR ANALYSIS AT X = -1.332 ( 6.917 FROM END OF TOE) (+ V = END DOWN) ---
LOAD       V           N (COMP +)        M          UNIT SHEAR    ALLOWABLE   ACI318-77
CASE  LB    SLICE     LB    SLICE   LB-FT/SLICE   STRESS  PSI   UNIT STRESS PROVISION
----  ----------     ----------   -----------   -----------   ----------- ---------
 2    -7236.9         2859.1       -26586.        35.562        60.651     B.7.4.5

MOMENT AT THE STEM (POINT 2)--

FLEXURE ANALYSIS AT X = -0.001 ( 8.249 FROM END OF TOE) (+ M = TENSION IN TOP)
LOAD  N (COMP=+)        M            FC      FS
CASE  LB    SLICE  LB-FT/SLICE     PSI     PSI
----  ----------   -----------    -----   ------
 2       2871.        -37012.      826.   13372.

TOE ANALYSIS COMPLETE TO STEM

SELECT TYPE C, S, OR F ANALYSIS FOR TOE   (OR ?, N, R, OR *):
?N

         14:54:55 ON  9/17/80

**
** BEGIN HEEL STRESS ANALYSIS
**

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *):
?C


SHEAR AND MOMENT AT THE STEM--

--- SHEAR ANALYSIS AT X =  2.501 (14.249 FROM END OF HEEL) (+V = END DOWN) ---
LOAD       V           N (COMP +)        M          UNIT SHEAR    ALLOWABLE   ACI318-77
CASE  LB    SLICE     LB    SLICE   LB-FT SLICE   STRESS  PSI   UNIT STRESS PROVISION
----  ----------     ----------   -----------   -----------   ----------- ---------
 2     5642.7        -35.073       44640.         26.870        60.216     B.7.4.3

FLEXURE ANALYSIS AT X =  2.501 (14.249 FROM END OF HEEL) (+M = TENSION IN TOP
LOAD  N (COMP=+)        M            FC      FS
CASE  LB / SLICE   LB-FT/SLICE     PSI     PSI
----  ----------   -----------    -----   ------
 2       -35.         44640.      1164.   28108.

HEEL ANALYSIS COMPLETE TO END

SELECT TYPE C, S, OR F ANALYSIS FOR HEEL (OR ?, N, R, OR *):
?N

**
** MODULE WA COMPLETE
**
```

```
:
: UPDATE FILE RESET
:


:
: COMMAND-DATA PHASE ENTERED
:

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?5
ENTER YOUR ADP CENTER TERMINAL MACON STATION CODE
?R0

INUMB : 2998A


YOUR UPDATE FILE FOR FUTURE RESTART IS NAMED EXV6UPD
STOP     OK (RELEASE UNNEEDED FILES)

•
```

```
$FORTRAN
$RUN WESLIB/TWDA,R

        09/18/80    10.222


PROGRAM TWDA -- 713-F3-R0 027
   T-WALL DESIGN/ANALYSIS
       REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EXWGTEMP


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?W.A.P.
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?


IS THIS AN INITIAL RUN OR A RESTART OF A PREVIOUS RUN?
ENTER 'INIT' OR 'REST'

COMMAND
?REST EXWGUPD

$- ALL DATA RESET FOR FRESH START -$
$- COMMON DATA RESET FROM RESTART FILE EXWGUPD , UPDATE FILE RESET -$

COMMAND
?RUN FA

         10:14:54 ON  9/18/80

         10:14:55 ON  9/18/80

         10:14:55 ON  9/18/80

         10:14:57 ON  9/18/80

THE RESULTANT RATIO =      0.2303, FOR LOAD CASE  2

         10:14:58 ON  9/18/80


FINAL FACTOR OF SAFETY AGAINST SLIDING =     1.13, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'    TANPHI'=TANPHI/FS

         10:15: 6 ON  9/18/80

         10:15: 6 ON  9/18/80


TOTAL CONCRETE VOLUME =         81.82 (CU FT / LF), FOR LOAD CASE  2

         10:15: 7 ON  9/18/80

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
   OR 0 TO OMIT THE PLOTS
?1
```

```
NOTE --- A BELL WILL RING AT SELECTED TIMES
         TO ALLOW YOU TO MAKE A HARDCOPY IF
         YOU SO DESIRE. TO RESUME EXECUTION
         SIMPLY ENTER A CARRIAGE RETURN

ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      3 TO TERMINATE GRAPHICS
?1
ACTIVE LOAD CASES
****** **** *****
                2
ENTER DESIRED ACTIVE LOADCASE
?2
```


RERUN EXAMPLE U8, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
LOAD CASE 2
3
1
7
3



RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
LOAD CASE 2
0.
0.
0.
22.
25.
2048.
PASSIVE
EARTH
653.9
WATER
1188.
WATER
653.9
1188.
UPLIFT
1506.
0.
BEARING
1506. LBS
PRESSURE SCALE

```
ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      * TO TERMINATE GRAPHICS
?*
$$$

$
$ UPDATE FILE RESET
$


$
$ COMMAND-DATA PHASE ENTERED
$

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?1

your update file for future restart is named EXV6TEMP
stop    OK (release unneeded files)

*RELE EXV6TEMP
FILE RELEASED-EXV6TEMP
*
```

7-4 REPORT FILE PRINTOUT:

```
RRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRRR
          14:44:38 ON  9/17/80



NOTES TO EXPLAIN SPECIAL PRINTOUT THAT MIGHT BE IN THIS FILE--

THE VALUE "-.1234E+31" IS USED TO DENOTE AN  UNDEFINED ITEM;
THE VALUE "-.1432E+31" MEANS THAT THE DEFAULT VALUE WAS REQUESTED.

A "MEMORY FAULT AT ..." MESSAGE PROBABLY MEANS THAT NEEDED DATA IS UNDEFINED.

.

END OF NOTES.

COMMAND ENTERED:
REST EXV2UPD
*- COMMON DATA RESET FROM RESTART FILE EXV2UPD , UPDATE FILE RESET -*

COMMAND ENTERED:
CASE  1  2

COMMAND ENTERED:
SOLP  2  S  S  S  S  0.2  0.0  S

COMMAND ENTERED:
NAME  RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE

COMMAND ENTERED:
UPDATE

#
# UPDATE FILE RESET
#

COMMAND ENTERED:
TRCE 3

COMMAND ENTERED:
RUN EA
```

```
RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:49:25 ON  9/17/80

#
# BEGIN BASIC STABILITY DATA CHECK
#
> VALUE OF GAMAW      FOUND =    62.50000     IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF GAMAC      FOUND =    150.0000     IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF FSS        FOUND =    1.000000     IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF FXW        FOUND =    2.000000     IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF UCFXS3     FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF UCFXS4     FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF UCFXS5     FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF UCBFS1     FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF UCBFS2     FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF UCBFE7     FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF UCBFS7     FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF UCBFS6     FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF UCWS       FOUND =    1.000000     IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF UCWB       FOUND =    1.000000     IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF UCWK       FOUND =    1.000000     IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF IFWOC      FOUND =           2     IN S/R CHEKIT (LOAD CASE  2)
> VALUE OF IFSOM      FOUND =           1     IN S/R CHEKIT (LOAD CASE  2)
> VALUE OF CEMA       FOUND =    1.000000     IN S/R CHEKRT (LOAD CASE  2)
NO DEFAULT VALUE FOR RRMIN       SO SET TO UNDEFINED  (LOAD CASE  2)
> VALUE OF KRACK      FOUND =           1     IN S/R CHEKIT (LOAD CASE  2)
> VALUE OF FSMIN      FOUND =    1.500000     IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF NSLIDE     FOUND =           2     IN S/R CHEKIT (LOAD CASE  2)
> VALUE OF HGSW       FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF DS1H(LC)   FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF WDS2(LC)   FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF HS3(LC)    FOUND =    100.0000     IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF FSS        FOUND =    1.000000     IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF FXW        FOUND =    2.000000     IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF HSS5H      FOUND =    100.0000     IN S/R CHEKRT (LOAD CASE  2)
> VALUE OF DTS5H      FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)
```

```
RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:49:25 ON  9/17/80


#
# BEGIN PART 2 OF STABILITY DATA CHECK
#
```



```
RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:49:25 ON  9/17/80
```



```
#
# BEGIN MODULE FA
#
```

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	65.0000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	0.	44.8438	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	0.	44.8438	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-8.2500	44.5000	TOP OF TOEHT = AT OUTER END OF TW2
5	-8.2500	43.0000	TOE END OF BASE = AT BTE1
10	16.7500	43.0000	HEEL END OF BASE
11	16.7500	44.5000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	2.5000	44.7500	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.5000	65.0000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM.
14	1.5000	65.0000	TOP OF HEEL-SIDE FACE OF STEM
15	16.2500	43.0000	BOTTOM OF CUTOFF WALL UNDER KEY

WITH HEEL EARTH CRACKED(KRACK=1 FOR LOAD CASE= 2)
W3-W4 ARE THE TOP AND BOTTOM VALUES OF THE PRESSURE DIAGRAM
USED IN ADDITION TO HYDROSTATIC PRESSURE OF STILL WATER. CREEP PATH
STARTS AT THE BOTTOM OF THE CRACK UNLESS THE VERTICAL RESULTANT IS
OUTSIDE THE KERN TOWARD THE TOE.

```
# HORIZONTAL NON-SEEPAGE PRESSURES ARE ZERO
# BECAUSE YOUR KRACK VALUE OF 1 CANCELS ACTIVE EARTH
# AND BECAUSE PRESSURES W3 AND/OR W4 (DATA LIST SCHH)
# ARE UNDEFINED, ZERO, OR NEGATIVE.
```

THE FOLLOWING TABLE INCLUDES WALL AND SOIL+WATER MASS ABOVE BASE, AND THE FORCES ACTING ON IT, EXCEPT THAT HORIZONTAL SEEPAGE AND UPLIFT ARE NOT INCLUDED HERE. "ACTIVE EARTH" INCLUDES THE W3-W4 WATER PRESSURE IF A CRACK IS ASSUMED IN THE EARTH COVER OVER THE END OF THE HEEL.

LOAD CASE 2

	VERTICAL FORCE LB/SLICE	HORIZONTAL FORCE LB/SLICE	MOMENT LB-FT/SLICE
WALL	12273.63	0.	132834.67
ACTIVE EARTH	0.	0.	0.
SOIL+WATER	25798.88	0.	385582.24
SURCHARGES	0.	0.	0.
DIRECT LOADS	0.	0.	0.
WIND	0.	0.	0.
EARTHQUAKE	0.	8648.04	-50066.99
TOTAL	38072.52	8648.04	468349.92

```
RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:49:27 ON  9/17/80


*
* BEGIN THE OVERTURNING COMPUTATION
*


   LOAD CASE   2


CREEP PATH DESCRIPTION FOR LOAD CASE 2

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
   16.75              62.00                  0.
   16.75              43.00               1187.50
   16.75              43.00               1187.50
   16.75              43.00               1187.50
   -8.25              43.00                601.56
   -8.25              50.00                  0.

 OVERTURNING HYDRAULIC GRADIENT  =  0.3750


 > VALUE OF NPPD(LC)    FOUND =          1        IN S/R CHEKIT (LOAD CASE  2)

 > VALUE OF ADHS3       FOUND =    400.0000       IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF PHIS3       FOUND =    15.00000       IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF ADHS4       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF ADHS5       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF PHIS4       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF PHIS5       FOUND =   0.              IN S/R CHEKRT (LOAD CASE  2)


   AT BASE-SOIL INTERFACE:
     WEIGHTED AVERAGE COEFFICIENT OF FRICTION =        0.27
     WEIGHTED AVERAGE ADHESION                =      400.00 (LBS/SQ.FT)
     EFFECTIVE BASE WIDTH                     =       25.00 (FEET)
     EFFECTIVE LENGTH ALONG BASE SLOPE        =       25.00 (FEET)
     NORMAL FORCE ACTING ON BASE              =    15709.23 (LBS/SLICE)
     FRICTIONAL FORCE                         =     4209.28 (LBS/SLICE)
     FORCE DUE TO ADHESION                    =    10000.00 (LBS/SLICE)
     TOTAL FORCE ALONG BASE                   =    14209.28 (LBS/SLICE)
     HORIZONTAL COMPONENT OF TOTAL FORCE      =    14209.28 (LBS/SLICE)
```

```
PASSIVE EARTH PRESSURES FOR LOAD CASE  2

NPPD                                 =          1
ELEVATION OF TOP OF SOIL             =   50.082      (FT)
PRESSURE AT TOP OF SOIL              =  0.           (LBS/SQ.FT)
ELEVATION AT BOTTOM OF TOE           =   43.000      (FT)
PRESSURE AT BOTTOM OF TOE            =  -1020.7      (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL    =   43.000      (FT)
PRESSURE AT LOWEST POINT ON WALL     =  -1020.7      (LBS/SQ.FT)
PASSIVE EARTH FORCE                  =  -3614.5      (LBS/SLICE)
PASSIVE EARTH MOMENT                 =   8533.3      (FT-LBS/SLICE)


>  BEGIN SEARCHING FOR AN EFFECTIVE BASE


CREEP PATH DESCRIPTION FOR LOAD CASE 2


X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
   16.75              62.00                 0.
   16.75              43.00              1187.50
   16.75              43.00              1187.50
   16.75              43.00              1187.50
   16.75              43.00              1187.50
   10.83              43.00              1187.50
   -8.25              43.00               638.79
   -8.25              50.00                 0.

 OVERTURNING HYDRAULIC GRADIENT  =  0.4601


 > VALUE OF NPPD(LC)    FOUND =           1        IN S/R CHEKIT (LOAD CASE  2)

 > VALUE OF ADHS3       FOUND =     400.0000       IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF PHIS3       FOUND =     15.00000       IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF ADHS4       FOUND =   0.               IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF ADHS5       FOUND =   0.               IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF PHIS4       FOUND =   0.               IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF PHIS5       FOUND =   0.               IN S/R CHEKRT (LOAD CASE  2)



   AT BASE-SOIL INTERFACE:
     WEIGHTED AVERAGE COEFFICIENT OF FRICTION =        0.27
     WEIGHTED AVERAGE ADHESION                =      400.00 (LBS/SQ.FT)
     EFFECTIVE BASE WIDTH                     =       19.08 (FEET)
     EFFECTIVE LENGTH ALONG BASE SLOPE        =       19.08 (FEET)
     NORMAL FORCE ACTING ON BASE              =    13620.01 (LBS/SLICE)
     FRICTIONAL FORCE                         =     3649.47 (LBS/SLICE)
     FORCE DUE TO ADHESION                    =     7632.50 (LBS/SLICE)
     TOTAL FORCE ALONG BASE                   =    11281.97 (LBS/SLICE)
     HORIZONTAL COMPONENT OF TOTAL FORCE      =    11281.97 (LBS/SLICE)
```

```
PASSIVE EARTH PRESSURES FOR LOAD CASE  2

NPPD                                    =          1
ELEVATION OF TOP OF SOIL                =   50.082       (FT)
PRESSURE AT TOP OF SOIL                 =  0.            (LBS/SQ.FT)
ELEVATION AT BOTTOM OF TOE              =   43.000       (FT)
PRESSURE AT BOTTOM OF TOE               =  -1810.5       (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL       =   43.000       (FT)
PRESSURE AT LOWEST POINT ON WALL        =  -1810.5       (LBS/SQ.FT)
PASSIVE EARTH FORCE                     =  -6411.5       (LBS/SLICE)
PASSIVE EARTH MOMENT                    =   15137.       (FT-LBS/SLICE)

CREEP PATH DESCRIPTION FOR LOAD CASE 2

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
   16.75              62.00                     0.
   16.75              43.00                  1187.50
   16.75              43.00                  1187.50
   16.75              43.00                  1187.50
   16.75              43.00                  1187.50
    9.27              43.00                  1187.50
   -8.25              43.00                   651.60
   -8.25              50.00                     0.

 OVERTURNING HYDRAULIC GRADIENT  =  0.4894


 > VALUE OF NPPD(LC)    FOUND =           1        IN S/R CHEKIT (LOAD CASE  2)

 > VALUE OF ADHS3       FOUND =     400.0000       IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF PHIS3       FOUND =     15.00000       IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF ADHS4       FOUND =   0.               IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF ADHS5       FOUND =   0.               IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF PHIS4       FOUND =   0.               IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF PHIS5       FOUND =   0.               IN S/R CHEKRT (LOAD CASE  2)


   AT BASE-SOIL INTERFACE:
     WEIGHTED AVERAGE COEFFICIENT OF FRICTION =         0.27
     WEIGHTED AVERAGE ADHESION                =       400.00  (LBS/SQ.FT)
     EFFECTIVE BASE WIDTH                     =        17.52  (FEET)
     EFFECTIVE LENGTH ALONG BASE SLOPE        =        17.52  (FEET)
     NORMAL FORCE ACTING ON BASE              =     13079.78  (LBS/SLICE)
     FRICTIONAL FORCE                         =      3504.72  (LBS/SLICE)
     FORCE DUE TO ADHESION                    =      7008.44  (LBS/SLICE)
     TOTAL FORCE ALONG BASE                   =     10513.15  (LBS/SLICE)
     HORIZONTAL COMPONENT OF TOTAL FORCE      =     10513.15  (LBS/SLICE)
```

PASSIVE EARTH PRESSURES FOR LOAD CASE 2

```
NPPD                                 =          1
ELEVATION OF TOP OF SOIL             =    50.082      (FT)
PRESSURE AT TOP OF SOIL              =  0.            (LBS/SQ.FT)
ELEVATION AT BOTTOM OF TOE           =    43.000      (FT)
PRESSURE AT BOTTOM OF TOE            =  -2015.0       (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL    =    43.000      (FT)
PRESSURE AT LOWEST POINT ON WALL     =  -2015.0       (LBS/SQ.FT)
PASSIVE EARTH FORCE                  =  -7135.5       (LBS/SLICE)
PASSIVE EARTH MOMENT                 =    16846.      (FT-LBS/SLICE)
```

CREEP PATH DESCRIPTION FOR LOAD CASE 2

X-COORDINATES	Y-COORDINATES	HYDROSTATIC PRESSURE
16.75	62.00	0.
16.75	43.00	1187.50
16.75	43.00	1187.50
16.75	43.00	1187.50
16.75	43.00	1187.50
9.02	43.00	1187.50
-8.25	43.00	653.85
-8.25	50.00	0.

OVERTURNING HYDRAULIC GRADIENT = 0.4945

```
> VALUE OF NPPD(LC)   FOUND =          1        IN S/R CHEKIT (LOAD CASE  2)

> VALUE OF ADHS3      FOUND =     400.0000      IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF PHIS3      FOUND =     15.00000      IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF ADHS4      FOUND =   0.              IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF ADHS5      FOUND =   0.              IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF PHIS4      FOUND =   0.              IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF PHIS5      FOUND =   0.              IN S/R CHEKRT (LOAD CASE  2)
```

```
AT BASE-SOIL INTERFACE:
  WEIGHTED AVERAGE COEFFICIENT OF FRICTION =        0.27
  WEIGHTED AVERAGE ADHESION                =      400.00 (LBS/SQ.FT)
  EFFECTIVE BASE WIDTH                     =       17.27 (FEET)
  EFFECTIVE LENGTH ALONG BASE SLOPE        =       17.27 (FEET)
  NORMAL FORCE ACTING ON BASE              =    12991.92 (LBS/SLICE)
  FRICTIONAL FORCE                         =     3481.18 (LBS/SLICE)
  FORCE DUE TO ADHESION                    =     6906.31 (LBS/SLICE)
  TOTAL FORCE ALONG BASE                   =    10387.49 (LBS/SLICE)
  HORIZONTAL COMPONENT OF TOTAL FORCE      =    10387.49 (LBS/SLICE)
```

```
PASSIVE EARTH PRESSURES FOR LOAD CASE  2

NPPD                                    =          1
ELEVATION OF TOP OF SOIL                =   50.082      (FT)
PRESSURE AT TOP OF SOIL                 =  0.           (LBS/SQ.FT)
ELEVATION AT BOTTOM OF TOE              =   43.000      (FT)
PRESSURE AT BOTTOM OF TOE               =  -2048.2      (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL       =   43.000      (FT)
PRESSURE AT LOWEST POINT ON WALL        =  -2048.2      (LBS/SQ.FT)
PASSIVE EARTH FORCE                     =  -7253.3      (LBS/SLICE)
PASSIVE EARTH MOMENT                    =   17124.      (FT-LBS/SLICE)


>  EFFECTIVE BASE FOUND


RESULTANT IS OUTSIDE THE KERN ON THE TOE SIDE



EFFECTIVE BASE =  17.27 (FT),
COORDINATES OF ZERO PRESSURE ON THE BASE:
   XZ =   9.02 AND YZ =  43.00

CREEP PATH DESCRIPTION FOR LOAD CASE 2

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
   16.75               62.00                   0.
   16.75               43.00                1187.50
   16.75               43.00                1187.50
   16.75               43.00                1187.50
   16.75               43.00                1187.50
    9.02               43.00                1187.50
   -8.25               43.00                 653.85
   -8.25               50.00                   0.

 OVERTURNING HYDRAULIC GRADIENT  =  0.4945


 > VALUE OF NPPD(LC)      FOUND =          1        IN S/R CHEKIT (LOAD CASE  2)

 > VALUE OF ADHS3         FOUND =    400.0000       IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF PHIS3         FOUND =    15.00000       IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF ADHS4         FOUND =   0.              IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF ADHS5         FOUND =   0.              IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF PHIS4         FOUND =   0.              IN S/R CHEKRT (LOAD CASE  2)

 > VALUE OF PHIS5         FOUND =   0.              IN S/R CHEKRT (LOAD CASE  2)
```

```
AT BASE-SOIL INTERFACE:
  WEIGHTED AVERAGE COEFFICIENT OF FRICTION =        0.27
  WEIGHTED AVERAGE ADHESION                =      400.00 (LBS/SQ.FT)
  EFFECTIVE BASE WIDTH                     =       17.27 (FEET)
  EFFECTIVE LENGTH ALONG BASE SLOPE        =       17.27 (FEET)
  NORMAL FORCE ACTING ON BASE              =    12991.92 (LBS/SLICE)
  FRICTIONAL FORCE                         =     3481.18 (LBS/SLICE)
  FORCE DUE TO ADHESION                    =     6906.31 (LBS/SLICE)
  TOTAL FORCE ALONG BASE                   =    10387.49 (LBS/SLICE)
  HORIZONTAL COMPONENT OF TOTAL FORCE      =    10387.49 (LBS/SLICE)


PASSIVE EARTH PRESSURES FOR LOAD CASE  2

NPPD                              =           1
ELEVATION OF TOP OF SOIL          =    50.082      (FT)
PRESSURE AT TOP OF SOIL           =  0.            (LBS/SQ.FT)
ELEVATION AT BOTTOM OF TOE        =    43.000      (FT)
PRESSURE AT BOTTOM OF TOE         =  -2048.2       (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL =    43.000      (FT)
PRESSURE AT LOWEST POINT ON WALL  =  -2048.2       (LBS/SQ.FT)
PASSIVE EARTH FORCE               =  -7253.3       (LBS/SLICE)
PASSIVE EARTH MOMENT              =   17124.       (FT-LBS/SLICE)

DISTANCE FROM THE TOE TO THE RESULTANT          =  5.76 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE   =    -25080.59 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES   =      8992.76 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES  =  -410687.91 (FT-LBS/SLICE)

THE RESULTANT RATIO =       0.2303, FOR LOAD CASE  2
```

```
REHUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:49:29 ON  9/17/80


#
# BEGIN SLIDING COMPUTATION
#


FINAL FACTOR OF SAFETY AGAINST SLIDING =      1.13, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

    SUM OF DRIVING FORCES  = 17640.797 (LBS/SLICE)
    SUM OF RESISTING FORCES = 17646.204 (LBS/SLICE)

    PASSIVE EARTH FORCE                       =    7472.24 (LBS/SLICE)
    ACTIVE EARTH FORCE                        =    8648.00 (LBS/SLICE)
    UPLIFT FORCE                              =  -25080.59 (LBS/SLICE)
    SUMMATION OF HORIZONTAL WATER FORCES =    8992.76 (LBS/SLICE)

     FAILURE PATH COORDINATES UNDER THE NEUTRAL BLOCK
        X          Y
      -8.25      43.00
      16.75      43.00


REHUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:49:47 ON  9/17/80


#
#  BEGIN ALLOWABLE BEARING CAPACITY COMPUTATIONS
#


> VALUE OF ELBS3       FOUND =     33.00000      IN S/R CHEKRT (LOAD CASE  2)

ELBS3 SET TO 10 FEET BELOW LOWEST POINT ON BASE


ALLOWABLE BEARING PRESSURES WILL NOT BE COMPARED
TO THE ACTUAL BEARING PRESSURES BECAUSE THE ALLOWABLES WERE NOT DEFINED.


FOR LOAD CASE  2,

FOR THE BASE COORDINATES  X= -8.25  Y= 43.00, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE        =    1504.93 (LBS/SQ.FT)

FOR THE BASE COORDINATES  X=  9.02  Y= 43.00, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE        =       0.    (LBS/SQ.FT)

FOR THE BASE COORDINATES  X= 16.75  Y= 43.00, THE ABSOLUTE VALUE OF:
THE ACTUAL BEARING PRESSURE        =       0.    (LBS/SQ.FT)
```

```
REPUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:09:48 ON  9/17/80


#
# BEGIN COST ANALYSIS
#
```

COST & VOLUME OF EXCAVATED MATERIAL

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
3	0.	0.	0.
4	0.	0.	0.
5	0.	0.	0.

COST & VOLUME OF BACKFILL MATERIAL.

SOIL LAYER	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
1	0.	0.	0.
2	0.	0.	0.
FILTER ZONE	0.	0.	0.
7	0.	0.	0.
6	0.	0.	0.

COST & VOLUME OF CONCRETE

SECTION	VOLUME (CU.FT/L.FT)	UNIT COST (DOLLARS/CU.FT)	TOTAL COST (DOLLARS/L.FT)
STEM	40.38	1.00	40.38
BASE	41.44	1.00	41.44
KEY	0.	1.00	0.

```
TOTAL CONCRETE VOLUME =        81.82 (CU FT / LF), FOR LOAD CASE  2

#
# BEGIN BOIL CONTROL CALCULATIONS FOR LOAD CASE  2
#

THE COMPUTED CREEP RATIO FOR A TIP ELEV. OF   43.00 IS      2.1650

ENTERING S/R  LOADARRAY
```

```
RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
         14:49:49 ON  9/17/80


*
* BEGIN DATA CHECK FOR ACTIVE EARTH PRESSURES COMPUTATION
*

> VALUE OF DS1H(LC)    FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF WDS2(LC)    FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF HS3(LC)     FOUND =    100.0000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF ESS         FOUND =    1.000000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF EXH         FOUND =    2.000000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF HSS5H       FOUND =    100.0000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF DTS5H       FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF GAMAS1(LC)  FOUND =    125.0000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF COH1(LC)    FOUND =    400.0000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF PHI1(LC)    FOUND =    15.00000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF DELTA1(LC)  FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF RKH(LC)     FOUND =   0.2000000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF ELWH(LC)    FOUND =    62.00000     IN S/R CHEKRT (LOAD CASE  2)

        ENTERING S/R CLASSIC FROM MODULE SA-SP


 COULOMB'S COEFFICIENTS OF ACTIVE EARTH PRESSURES FOR:
    BACKFILL LAYER          KA VALUE
    ..............          ........
          1                  0.6049


    COORDINATES AND STATIC ACTIVE SOIL PRESSURES
    FOR EACH SOIL LAYER

      COORDINATES         ACTIVE           ACTIVE
      AT WALL  (FT)      PRESSURE          COEFF.
       X       Y          (PSF)
      2.24    50.00         0.         0.6049
      2.50    44.75         0.         0.6049
```

```
STATIC ACTIVE SOIL FORCES

 Y-COORD              SOIL FORCE (LB/FT)
  (FT)              HORIZONTAL     VERTICAL
   50.00                0.            0.
   49.00                0.            0.
   48.00                0.            0.
   47.00                0.            0.
   46.00                0.            0.
   45.00                0.            0.
   44.75                0.            0.


COORDINATES AND EARTHQUAKE ACTIVE SOIL PRESSURES
FOR EACH SOIL LAYER

               ACTIVE              ACTIVE
 Y-COORD      PRESSURE             COEFF.
  (FT)         (PSF)
   50.00        0.                 0.8238
   44.75      143.62               0.8238

     HORIZONTAL ACTIVE EARTH PRESSURES FOR LOAD CASE  2
     FOR CLASSIC(COULOMB) ANALYSIS IN SP (FACE OF STEM)


     OUTPUT OF ARRAYS HS, EHS, AND YVS IN MODULE SP FOR CLASSIC ANALYSIS.

      ELEVATION  INCREMENTAL HORIZONTAL  INCREMENTAL HORIZONTAL
                       STATIC FORCE          EARTHQUAKE FORCE
         (FT)           (LBS/FT)                 (LBS/FT)
      ---------  ----------------------  ----------------------
       50.000             0.                     67.331
       49.000             0.                     116.40
       48.000             0.                     89.014
       47.000             0.                     61.625
       46.000             0.                     34.236
       45.000             0.                     8.5590
       44.750             0.                     0.28530

     FOR THE ABOVE LOAD CASE THE RESULTANT FORCES ARE:

     RESULTANT HORIZONTAL STATIC ACTIVE FORCE =        0.    LBS/HORIZ FT
     ACTING AT ELEVATION      0.

     RESULTANT HORIZONTAL ACTIVE FORCE (IN EXCESS OF STATIC)
     DUE TO EARTHQUAKE =      377.45 LBS/HORIZ FT
     ACTING AT ELEVATION     48.25


#
# EXIT MODULE EA
#


 #
 # UPDATE FILE RESET
 #

 COMMAND ENTERED:
 RUN WA
```

```
RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:50:32 ON  9/17/80

#
# BEGIN MODULE WA
#

> VALUE OF BW          FOUND =    25.00000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF BS          FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF BTF1        FOUND =    43.00000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF BASER       FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF ETS         FOUND =    65.00000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF TSB         FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF HSTPH       FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF TW1         FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF TS2         FOUND =    24.00000     IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF KFLAG       FOUND =           0     IN S/R CHEKIT (LOAD CASE  2)

> VALUE OF DKEY        FOUND =   0.            IN S/R CHEKRT (LOAD CASE  2)

> VALUE OF HSRPR       FOUND =   0.5925926     IN S/R CHEKRT (LOAD CASE  2)

SLOPE OF TOP OF HEEL SLAB =  57.00 H : 1 V (100.0:1 = LEVEL)
```

COORDINATES OF CORNERS OF WALL CROSS-SECTION

X-COORDINATES ARE + TOWARD HEEL FROM BASIC WORKING POINT (BWP)
Y-COORDINATES ARE ELEVATIONS

PT.	X	Y	DESCRIPTION OF POINT
1	0.	65.0000	BASIC WORKING POINT = TOE-SIDE OF STEM TOP
2	0.	44.8438	BOTTOM OF TOE-SIDE FACE OF STEM (AT TS1)
3	0.	44.8438	BETWEEN TS1 AND TS2, ON TOP FACE OF TOE
4	-8.2500	44.5000	TOP OF TOEHT = AT OUTER END OF TW2
5	-8.2500	43.0000	TOE END OF BASE = AT BTF1
10	16.7500	43.0000	HEEL END OF BASE
11	16.7500	44.5000	TOP OF HEELT2 = TOP OF OUTER END OF HEEL
12	2.5000	44.7500	BOTTOM OF HEEL-SIDE FACE OF STEM
13	1.5000	65.0000	BOTTOM OF HEEL-SIDE TOP PANEL OF STEM
14	1.5000	65.0000	TOP OF HEEL-SIDE FACE OF STEM
15	16.2500	43.0000	BOTTOM OF CUTOFF WALL UNDER KEY

```
WITH BASE RADIUS ("BAS      0 FOR RECTANGULAR) =      0.   FEET,
TOE END OF BASE UNIT WI        1.0000 FT. AND
HEEL END OF BASE UNIT WIDTH     .0000 FT.
(BASIC WORKING POINT IS 1.0 FT. WIDE).

WALL DATA LISTS:

WLA      ETS              TW2            STR             HEELW
     65.00000         8.250000       0.3300000        14.25000

WLAB     BW               BS                            BASER (LIST=WLBR)
     25.00000         0.                              0.
```

WLAH HEELT2 HEELW HEELT1
18.00000 14.25000 21.00000

WLAK KFLAG DKEY WKEY RKTF
0 0. 0. 100.0000

WLAS TSTT TSH TSTA HSTPH HSTPB
18.00000 0. 30.00000 0. 0.
HSBPB
0.5925926

WLAT BTE1 TOEHT TS2 TW1 TS1
43.00000 18.00000 24.00000 0. 100.0000

---- TMINB TMINS
-0.1234000E 31 -0.1234000E 31

LOWEST CONCRETE = 43.00 FT., AT HEEL END OF BASE
COMPARED WITH THE PREVIOUS LOW OF 43.000000 FT.

> Y-COORDINATES OF BASE SLAB SURFACE POINTS OPPOSITE CORNERS

BELOW 3	BELOW 2	ABOVE 6	BELOW 12
43.0000	43.0000	44.5000	43.0000

> TABLE OF STEEL VALUES IN STEM, SQ. IN. / FT.

M	ELEV.	ASTLST(M)	ASTLSH(M,1)	ASTLSH(M,2)	ASTLSH(M,3)
1	65.00	0.3100	0.4400	-0.1234E 31	-0.1234E 31
2	64.00	0.3100	0.4400	-0.1234E 31	-0.1234E 31
3	63.00	0.3100	0.4400	-0.1234E 31	-0.1234E 31
4	62.00	0.3100	0.4400	-0.1234E 31	-0.1234E 31
5	61.00	0.3100	0.4400	-0.1234E 31	-0.1234E 31
6	60.00	0.3100	0.4400	-0.1234E 31	-0.1234E 31
7	59.00	0.3100	0.4400	-0.1234E 31	-0.1234E 31
8	58.00	0.3100	0.4400	-0.1234E 31	-0.1234E 31
9	57.00	0.3100	0.4400	-0.1234E 31	-0.1234E 31
10	56.00	0.3100	0.4400	-0.1234E 31	-0.1234E 31
11	55.00	0.4400	1.000	-0.1234E 31	-0.1234E 31
12	54.00	0.4400	1.000	-0.1234E 31	-0.1234E 31
13	53.00	0.4400	1.000	-0.1234E 31	-0.1234E 31
14	52.00	0.4400	1.000	-0.1234E 31	-0.1234E 31
15	51.00	0.4400	2.000	-0.1234E 31	-0.1234E 31
16	50.00	0.4400	2.000	-0.1234E 31	-0.1234E 31
17	49.00	0.4400	2.000	-0.1234E 31	-0.1234E 31
18	48.00	0.4400	2.000	-0.1234E 31	-0.1234E 31
19	47.00	0.4400	2.000	-0.1234E 31	-0.1234E 31
20	46.00	0.4400	2.000	-0.1234E 31	-0.1234E 31
21	45.00	0.4400	2.000	-0.1234E 31	-0.1234E 31
22	44.00	0.4400	2.000	-0.1234E 31	-0.1234E 31

> TABLE OF STEEL VALUES IN BASE, SQ. IN. / FT.

M	DIST.	ASTLBT(M,1)	ASTLBT(M,2)	ASTLBH(M,1)	ASTLBH(M,2)	ASTLBH(M,3)
1	0.	0.4400	-0.1234E 31	1.000	-0.1234E 31	-0.1234E 31
2	1.00	0.4400	-0.1234E 31	1.000	-0.1234E 31	-0.1234E 31
3	2.00	0.4400	-0.1234E 31	1.000	-0.1234E 31	-0.1234E 31
4	3.00	0.4400	-0.1234E 31	1.000	-0.1234E 31	-0.1234E 31
5	4.00	0.4400	-0.1234E 31	1.000	-0.1234E 31	-0.1234E 31
6	5.00	0.4400	-0.1234E 31	2.000	-0.1234E 31	-0.1234E 31
7	6.00	0.4400	-0.1234E 31	2.000	-0.1234E 31	-0.1234E 31
8	7.00	0.4400	-0.1234E 31	2.000	-0.1234E 31	-0.1234E 31
9	8.00	0.4400	-0.1234E 31	2.000	-0.1234E 31	-0.1234E 31
10	9.00	0.4400	-0.1234E 31	2.000	-0.1234E 31	-0.1234E 31
11	10.00	1.200	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
12	11.00	1.200	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
13	12.00	1.200	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
14	13.00	1.200	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
15	14.00	1.200	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
16	15.00	1.200	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31

17	16.00	0.6000	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
18	17.00	0.6000	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
19	18.00	0.6000	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
20	19.00	0.6000	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
21	20.00	0.6000	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
22	21.00	0.6000	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
23	22.00	0.6000	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
24	23.00	0.6000	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
25	24.00	0.6000	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31
26	25.00	0.6000	-0.1234E 31	0.4400	-0.1234E 31	-0.1234E 31

---------- PRESSURE DATA VERIFICATION FOR LOAD CASE 2 ----------

FH TOP CALCULATED TO BE 62.000
FOR LOAD CASE 2

> FHTOP IS 62.000

> TABLE OF HORIZONTAL NET HYDRO PRESSURES FOR LC = 2

I	ELEV.	FH(LC,I)	FEH(LC,I)
1	62.00	0.	0.
2	61.00	62.50	35.34
3	60.00	125.0	49.97
4	59.00	187.5	61.20
5	58.00	250.0	70.67
6	57.00	312.5	79.01
7	56.00	375.0	86.55
8	55.00	437.5	93.49
9	54.00	500.0	99.94
10	53.00	562.5	106.0
11	52.00	625.0	111.7
12	51.00	687.5	117.2
13	50.00	656.6	122.4
14	49.00	639.0	0.
15	48.00	621.5	0.
16	47.00	603.9	0.
17	46.00	586.3	0.
18	45.00	568.8	0.
19	44.00	551.2	0.
20	43.00	533.6	0.
21	42.00	689.6	0.

> TABLE OF VERTICAL UPLIFT PRESSURES FOR LC = 2

I	DIST.	X-COORD.	FV(LC,I)
1	0.	-8.250	-653.9
2	1.00	-7.250	-684.8
3	2.00	-6.250	-715.7
4	3.00	-5.250	-746.6
5	4.00	-4.250	-777.5
6	5.00	-3.250	-808.4
7	6.00	-2.250	-839.3
8	7.00	-1.250	-870.2
9	8.00	-0.2500	-901.1
10	9.00	0.7500	-932.0
11	10.00	1.750	-962.9
12	11.00	2.750	-993.8
13	12.00	3.750	-1025.
14	13.00	4.750	-1056.
15	14.00	5.750	-1087.
16	15.00	6.750	-1117.
17	16.00	7.750	-1148.
18	17.00	8.750	-1179.
19	18.00	9.750	-1180.
20	19.00	10.75	-1181.
21	20.00	11.75	-1182.
22	21.00	12.75	-1183.
23	22.00	13.75	-1184.
24	23.00	14.75	-1185.
25	24.00	15.75	-1186.

```
   26   25.00    16.75        -1187.
   27   26.00    17.75        -1188.

> TABLE OF VERTICAL EARTH WEIGHT + SURCHARGE PRESSURES FOR LC =  2
   I    DIST.    X-COORD.        V(LC,I)
  OVER  TOE :
    1    0.      -8.250         341.1
    2    1.00   -7.250         338.5
    3    2.00   -6.250         335.9
    4    3.00   -5.250         333.3
    5    4.00   -4.250         330.7
    6    5.00   -3.250         328.1
    7    6.00   -2.250         325.5
    8    7.00   -1.250         322.9
    9    8.00  -0.2500         322.9
  OVER  HEEL:
   10    8.00  -0.2500         322.9
   11    9.00   0.7500         325.4
   12   10.00    1.750         326.5
   13   11.00    2.750         327.6
   14   12.00    3.750         328.7
   15   13.00    4.750         329.8
   16   14.00    5.750         330.9
   17   15.00    6.750         332.0
   18   16.00    7.750         333.1
   19   17.00    8.750         334.2
   20   18.00    9.750         335.3
   21   19.00    10.75         336.3
   22   20.00    11.75         337.4
   23   21.00    12.75         338.5
   24   22.00    13.75         339.6
   25   23.00    14.75         340.7
   26   24.00    15.75         341.8
   27   25.00    16.75         342.9
   28   26.00    17.75         344.0

> TABLE OF VERTICAL EARTH + SURCHARGE EARTHQUAKE PRESSURES FOR LC =  2
   I    DIST.    X-COORD.       EV(LC,I)
  OVER  TOE :
  OVER  HEEL:

> IRLT(LC) = -1 AND EPRW(LC) =  17.266 FOR LOAD CASE LC =  2:


> BEARING PRESSURE VALUES--FOR LOAD CASE  2--
     DATA   DATA   STRUCTURAL ANALYSIS     VALUE   (PSF)
     ITEM   LIST    SUBROUTINE OUTPUT    TOE<--    -->HEEL
     ----   ----   ------------------   ---------------

       DB   BPV      TAD - TVD - TMD     -0.E 31   -0.E 31
       VB   BPV      TAV - TVV - TMV      -1505.        0.
      EVB   BPV      TAE - TVE - TME     -0.E 31   -0.E 31
      EVB   BPV      TAE - TVE - TME     -0.E 31   -0.E 31

       HB   BPH      TAH - TVH - TMH     -0.E 31   -0.E 31
      EHB   BPH      TAE - TVE - TME     -0.E 31   -0.E 31
       HB   BPH      TAH - TVH - TMH     -0.E 31   -0.E 31
      EHB   BPH      TAE - TVE - TME     -0.E 31   -0.E 31

     ALL BEARING PRESSURES CALCULATED IN MODULE FA
      ARE TEMPORARILY INCLUDED IN DATA VALUE FOR VB.

> YTTOP   IS        50.082

> NPPD    IS            1

> KRACK   IS            1
```

> TABLE OF EARTH PRESSURE VALUES (LISTS ACPH & ACPS) FOR LOAD CASE 2

	----- OUTPUT OF MODULE SA ------ ON VERTICAL PLANE AT END OF HEEL			----- OUTPUT OF MODULE SP ------ -- ON HEEL-SIDE FACE OF STEM ---		
LOC	ELEV. YH FEET	STATIC H LB/SLICE	EQ. FH LB/SLICE	ELEV.YVS FEET	STATIC HS LB/SLICE	EQ. FHS LB/SLICE
1	0.	0.	0.	50.000	0.	67.331
2	0.	0.	0.	49.000	0.	116.40
3	0.	0.	0.	48.000	0.	89.014
4	0.	0.	0.	47.000	0.	61.625
5	0.	0.	0.	46.000	0.	34.236
6	0.	0.	0.	45.000	0.	8.5590
7	0.	0.	0.	44.750	0.	0.28530

--------------- END OF PRESSURE DATA VERIFICATION ---------------

> VALUE OF GAMAC FOUND = 150.0000 IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF GAMAW FOUND = 62.50000 IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF FPCON FOUND = 3000.000 IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF ESTI FOUND = 0.2900000E 08 IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF RATION FOUND = 9.190000 IN S/R CHEKRT (LOAD CASE 2)

> IFEM IS 0

> VALUE OF RATIOE FOUND = 0.3500000 IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF ESTIMX FOUND = 20000.00 IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF IFOR FOUND = 0 IN S/R CHEKIT (LOAD CASE 2)

> VALUE OF COVHS FOUND = 3.500000 IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF COVTS FOUND = 3.500000 IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF COVTB FOUND = 3.500000 IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF COVBB FOUND = 4.500000 IN S/R CHEKRT (LOAD CASE 2)

> VALUE OF SPABL FOUND = 2.370000 IN S/R CHEKRT (LOAD CASE 2)

COMBINED PASSIVE PRESSURE VALUE OF -2048.234 USED FOR LOAD CASE 2

```
RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:50:46 ON  9/17/80

#
# BEGIN STRESS ANALYSIS
#

> EXPLANATION OF "OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES" (FT, LB / SLICE)

  TAD, TAV, TAW, TAE, TAH, TAF, & CPPA ARE AXIAL FORCES
  TVD, TVV, TVW, TVE, TVH, TVF, WATERV, EWTV, & CPPV ARE SHEARS
  TMD, TMV, TMW, TME, TMH, TMF, WATERM, EWTM, & CPPM ARE MOMENTS

  TAD, TVD, & TMD ARE DUE TO THE FULL WEIGHT OF CONCRETE
  TAV, TVV, & TMV ARE DUE TO VERTICAL SURCHARGES
  TAW, TVW, & TMW ARE DUE TO WIND
  TAE, TVE, & TME ARE DUE TO EARTHQUAKE EFFECTS
  TAH, TVH, & TMH ARE DUE TO HORIZONTAL EARTH + SURCHARGES
  TAF, TVF, & TMF ARE DUE TO HORIZONTAL SEEPAGE + UPLIFT
  WATERV & WATERM ARE DUE TO THE WEIGHT OF WATER OVER BASE
  EWTV & EWTM ARE DUE TO THE WEIGHT OF EARTH OVER BASE EXCLUDING PORE WATER
  CPPA, CPPV, & CPPM ARE TOTAL PASSIVE PRESSURE, IF NON-ZERO
     (IF CPPA, ETC., ARE ZERO THEN THE PASSIVE PRESSURE
     EFFECTS ARE INCLUDED WITH THE LOADS CAUSING THEM.)
  ALL BEARING PRESSURES CALCULATED IN MODULE EA ARE TEMPORARILY INCLUDED
  IN TAV, TVV, AND TMV.  SIGN CONVENTION IS SHOWN IN MODULE WA OUTPUT.



RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:51:33 ON  9/17/80

#
# BEGIN STEM STRESS ANALYSIS
#
```

```
RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:51:45 ON  9/17/80

*
* BEGIN STRESS ANALYSIS
*


> EXPLANATION OF "OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES" (FT, LB / SLICE)

  TAD, TAV, TAW, TAE, TAH, TAF, & CPPA ARE AXIAL FORCES
  TVD, TVV, TVW, TVE, TVH, TVF, WATERV, EWTV, & CPPV ARE SHEARS
  TMD, TMV, TMW, TME, TMH, TMF, WATERM, EWTM, & CPPM ARE MOMENTS

  TAD, TVD, & TMD ARE DUE TO THE FULL WEIGHT OF CONCRETE
  TAV, TVV, & TMV ARE DUE TO VERTICAL SURCHARGES
  TAW, TVW, & TMW ARE DUE TO WIND
  TAE, TVE, & TME ARE DUE TO EARTHQUAKE EFFECTS
  TAH, TVH, & TMH ARE DUE TO HORIZONTAL EARTH + SURCHARGES
  TAF, TVF, & TMF ARE DUE TO HORIZONTAL SEEPAGE + UPLIFT
  WATERV & WATERM ARE DUE TO THE WEIGHT OF WATER OVER BASE
  EWTV & EWTM ARE DUE TO THE WEIGHT OF EARTH OVER BASE EXCLUDING PORE WATER
  CPPA, CPPV, & CPPM ARE TOTAL PASSIVE PRESSURE, IF NON-ZERO
     (IF CPPA, ETC., ARE ZERO THEN THE PASSIVE PRESSURE
     EFFECTS ARE INCLUDED WITH THE LOADS CAUSING THEM.)
  ALL BEARING PRESSURES CALCULATED IN MODULE FA ARE TEMPORARILY INCLUDED
  IN TAV, TVV, AND TMV.  SIGN CONVENTION IS SHOWN IN MODULE WA OUTPUT.
```

```
RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:52:20 ON  9/17/80


#
# BEGIN STEM STRESS ANALYSIS
#


SHEAR AT A DISTANCE D ABOVE THE BASE--

> OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES--
  --- LOAD CASE  2 ---
  TAD(LC), TVD(LC), TMD(LC) =       5276.148       0.               1087.253
  TAV(LC), TVV(LC), TMV(LC) =     0.             0.               0.
  TAW(LC), TVW(LC), TMW(LC) =     0.             0.               0.
  TAE(LC), TVE(LC), TME(LC) =     0.              2423.134         17133.86
  TAH(LC), TVH(LC), TMH(LC) =     0.             0.               0.
  TAF(LC), TVF(LC), TMF(LC) =     0.              6388.024         34684.14
  WATERV(LC), WATERM(LC) =                       0.               0.
  FWTV(LC), FWTM(LC) =                           0.               0.
  CPPA(LC), CPPV(LC), CPPM(LC) =  0.            -1439.715        -1514.300

----------------- SECTION PROPERTIES AT ELEVATION    46.93 ----------------
MOM.  COMP. FACE   OVERALL    EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE      K      J
----  ----------  ---------  ----------  -----------  -------  -----  -----
 +       12.00      28.71       25.21        2.00       HEEL
 -       12.00      28.71       25.21        0.44       TOE

--- SHEAR ANALYSIS AT ELEVATION    46.93  (+ V FROM TOP PUSHED TOWARD TOE) ---
LOAD       V         N (COMP +)       M         UNIT SHEAR    ALLOWABLE   ACI318-77
CASE  LB / SLICE   LB / SLICE   LB-FT/SLICE  STRESS  PSI  UNIT STRESS PROVISION
----  ----------   ----------  -----------  -----------  ----------- ---------
 2      7371.4       5276.1       51391.        24.367       60.803    8.7.4.5

MOMENT AT THE BASE--

> OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES--
  --- LOAD CASE  2 ---
  TAD(LC), TVD(LC), TMD(LC) =       6039.876       0.               1378.166
  TAV(LC), TVV(LC), TMV(LC) =     0.             0.               0.
  TAW(LC), TVW(LC), TMW(LC) =     0.             0.               0.
  TAE(LC), TVE(LC), TME(LC) =     0.              2618.675         22380.97
  TAH(LC), TVH(LC), TMH(LC) =     0.             0.               0.
  TAF(LC), TVF(LC), TMF(LC) =     0.              7605.367         49273.82
  WATERV(LC), WATERM(LC) =                       0.               0.
  FWTV(LC), FWTM(LC) =                           0.               0.
  CPPA(LC), CPPV(LC), CPPM(LC) =  0.            -3968.427        -6929.865


----------------- SECTION PROPERTIES AT ELEVATION    44.84 ----------------
MOM.  COMP. FACE   OVERALL    EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE      K      J
----  ----------  ---------  ----------  -----------  -------  -----  -----
 +       12.00      29.94       26.44        2.00       HEEL    0.287  0.904
 -       12.00      29.94       26.44        0.44       TOE     0.147  0.951

FLEXURE ANALYSIS AT ELEVATION    44.84 (+ M = TENSION AT HEEL)
LOAD  N (COMP=+)       M          FC      FS
CASE  LB / SLICE  LB-FT/SLICE     PSI     PSI
----  ----------  -----------   -----  ------
 2       6040.       66103.      791.  15016.
```

```
RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:53:45 ON  9/17/80

#
# BEGIN TOE STRESS ANALYSIS
#


SHEAR AT A DISTANCE D FROM THE STEM--


----- SECTION PROPERTIES AT X = -1.333  ( 6.917 FEET FROM END OF TOE) -----
MOM.  COMP. FACE    OVERALL    EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE       K      J
----  ----------  ---------  ----------  -----------  -------  -----  -----
 +       12.00      21.46      17.96        0.44        TOP
 -       12.00      21.46      16.96        2.00        BOTT

--- SHEAR ANALYSIS AT X = -1.333 ( 6.917 FROM END OF TOE) (+ V = END DOWN) ---
LOAD       V          N (COMP +)      M          UNIT SHEAR   ALLOWABLE  ACI318-77
CASE  LB / SLICE   LB / SLICE  LB-FT/SLICE   STRESS  PSI  UNIT STRESS PROVISION
----  ----------   ----------  -----------   -----------  ----------- ---------

> OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES--
  --- LOAD CASE  2 ---
  TAD(LC), TVD(LC), TMD(LC) =      0.                  1705.751       5726.714
  TAV(LC), TVV(LC), TMV(LC) =      0.                 -8339.800      -31252.45
  TAW(LC), TVW(LC), TMW(LC) =      0.                 0.             0.
  TAF(LC), TVF(LC), TMF(LC) =     -341.1502           0.             -23.86138
  TAH(LC), TVH(LC), TMH(LC) =      0.                 0.             0.
  TAE(LC), TVE(LC), TME(LC) =      0.                 -5233.475      -17331.83
  WATERV(LC), WATERM(LC) =                             2315.312       8078.930
  FWTV(LC), FWTM(LC) =                                 2315.312       8078.930
  CPPA(LC), CPPV(LC), CPPM(LC) =     3200.268         0.             137.8022

 2    -7236.9         2859.1      -26586.       35.562       60.651    8.7.4.5

MOMENT AT THE STEM (POINT 2)--


----- SECTION PROPERTIES AT X = -0.001  ( 8.249 FEET FROM END OF TOE) -----
MOM.  COMP. FACE    OVERALL    EFFECTIVE   REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN    FACE       K      J
----  ----------  ---------  ----------  -----------  -------  -----  -----
 +       12.00      22.13      18.63        0.44        TOP    0.173  0.942
 -       12.00      22.13      17.63        2.00        BOTT   0.339  0.887

FLEXURE ANALYSIS AT X = -0.001 ( 8.249 FROM END OF TOE) (+ M = TENSION IN TOP)
LOAD  N (COMP=+)        M         FC     FS
CASE  LB / SLICE  LB-FT/SLICE   PSI    PSI
----  ----------  -----------  -----  ------

> OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES--
  --- LOAD CASE  2 ---
  TAD(LC), TVD(LC), TMD(LC) =      0.                  2068.695       8239.945
  TAV(LC), TVV(LC), TMV(LC) =      0.                 -9468.094      -43135.82
  TAW(LC), TVW(LC), TMW(LC) =      0.                 0.             0.
  TAF(LC), TVF(LC), TMF(LC) =     -413.7389           0.             -34.33725
  TAH(LC), TVH(LC), TMH(LC) =      0.                 0.             0.
  TAE(LC), TVE(LC), TME(LC) =      0.                 -6437.519      -25136.59
  WATERV(LC), WATERM(LC) =                             2746.981       11451.75
  FWTV(LC), FWTM(LC) =                                 2746.981       11451.75
  CPPA(LC), CPPV(LC), CPPM(LC) =     3284.882         0.             151.0490

 2       2871.       -37012.     826.  13372.
```

```
RERUN EXAMPLE V2, LOAD CASE 2 PLUS 0.2 EARTHQUAKE
        14:54:55 ON  9/17/80

#
# BEGIN HEEL STRESS ANALYSIS
#

SHEAR AND MOMENT AT THE STEM--

----- SECTION PROPERTIES AT X =  2.501  (14.249 FEET FROM END OF HEEL) ----
MOM.  COMP. FACE    OVERALL    EFFECTIVE    REINFORCING  TENSION
SIGN  WIDTH, IN.  DEPTH IN.  DEPTH, IN.  AREA, SQ IN     FACE       K       J
----  ----------  ---------  ----------  -----------   -------  -----   -----
 +       12.00      21.00       17.50        1.20        TOP    0.276  0.908
 -       12.00      21.00       16.50        0.94        BOTT   0.183  0.939

--- SHEAR ANALYSIS AT X =  2.501 (14.249 FROM END OF HEEL) (+V = END DOWN) ---
LOAD       V          N (COMP +)        M          UNIT SHEAR   ALLOWABLE  ACI318-77
CASE  LB / SLICE    LB / SLICE   LB-FT/SLICE  STRESS  PSI  UNIT STRESS PROVISION
----  ----------    ----------   -----------  -----------  ----------- ---------

> OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES--
  --- LOAD CASE  2 ---
  TAD(LC), TVD(LC), TMD(LC) =      0.                  3473.175        24110.20
  TAV(LC), TVV(LC), TMV(LC) =      0.                 -1861.415        -4100.277
  TAW(LC), TVW(LC), TMW(LC) =      0.                0.               0.
  TAE(LC), TVE(LC), TME(LC) =       694.6350         0.                42.30077
  TAH(LC), TVH(LC), TMH(LC) =      0.                0.               0.
  TAF(LC), TVF(LC), TMF(LC) =       960.7650        -16229.37        -118806.6
  WATERV(LC), WATERM(LC) =                             15473.53         110505.5
  FWTV(LC), FWTM(LC) =                                 4786.781         34367.77
  CPPA(LC), CPPV(LC), CPPM(LC) =  -1690.473          0.               -1479.149

  2       5642.7        -35.073        44640.        26.870        60.216     8.7.4.3

FLEXURE ANALYSIS AT X =  2.501 (14.249 FROM END OF HEEL) (+M = TENSION IN TOP)
LOAD  N (COMP=+)        M           FC      FS
CASE  LB / SLICE   LB-FT/SLICE     PSI     PSI
----  ----------   -----------    -----   ------

> OUTPUT FROM STRUCTURAL ANALYSIS SUBROUTINES--
  --- LOAD CASE  2 ---
  TAD(LC), TVD(LC), TMD(LC) =      0.                  3473.175        24110.20
  TAV(LC), TVV(LC), TMV(LC) =      0.                 -1861.415        -4100.277
  TAW(LC), TVW(LC), TMW(LC) =      0.                0.               0.
  TAE(LC), TVE(LC), TME(LC) =       694.6350         0.                42.30077
  TAH(LC), TVH(LC), TMH(LC) =      0.                0.               0.
  TAF(LC), TVF(LC), TMF(LC) =       960.7650        -16229.37        -118806.6
  WATERV(LC), WATERM(LC) =                             15473.53         110505.5
  FWTV(LC), FWTM(LC) =                                 4786.781         34367.77
  CPPA(LC), CPPV(LC), CPPM(LC) =  -1690.473          0.               -1479.149

  2         -35.         44640.    1164.   28108.

#
# MODULE WA COMPLETE
#

#
# UPDATE FILE RESET
#

COMMAND ENTERED:
END
```

7-5 HAND CALCULATIONS

7-5-1 Additional Active Earth Pressures:

a. At end of heel (module SA). The crack precludes any active earth pressure here.

b. On face of stem (module SP). From the Program Criteria Specifications Document, paragraph 8.5.1b:

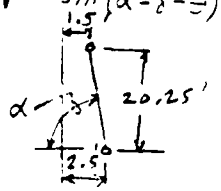
$$k_{2e} = \frac{\sin^2(\alpha + \phi - \theta)}{\cos\theta \, \sin^2\alpha \, \sin(\alpha - \delta - \theta)\left[1 + \sqrt{\dfrac{\sin(\phi+\delta)\,\sin(\phi-\beta-\theta)}{\sin(\alpha-\delta-\theta)\,\sin(\alpha+\beta)}}\right]^2}$$

$\alpha = \tan^{-1}\left(\frac{20.25}{1}\right) = 87.1729°$

$\beta = 0°$ (level ground)

$\delta = 0°$

$\phi = 15°$



$\theta = \tan^{-1}\left(\frac{k_h}{1-k_v}\right) = \tan^{-1}(k_h) = \tan^{-1}(0.2) = 11.31°$

$$k_{2e} = \frac{\sin^2(90+15-11.31)}{\cos(11.31)\,\sin^2(87.1729)\,\sin(75.8629)\left[1+\sqrt{\dfrac{\sin(15)\,\sin(15-11.31)}{\sin(75.8629)\,\sin(90)}}\right]^2}$$

$(\alpha - \delta - \theta) = 87.1729 - 11.31 = 75.8629°$

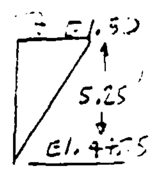
$$k_{2e} = \frac{0.99586}{0.98058(.997567)(.969714)\left[1+\sqrt{\dfrac{0.25882 \times 0.064358}{0.969714 \times 1}}\right]^2}$$

$K_{2e} = 0.82065$

$\Delta K_{2e} = 0.82065 - K_2 = \underset{\Delta K_{2e}}{0.82065 - 0.6049} = 0.21575$

Base pressure (inverted) $= \underset{\Delta K_{2e}}{.21575}(\underset{\gamma_s}{125})(\underset{h}{5.25}) = 141.59$ psf

Total force $= 141.59(5.25)\frac{1}{2} = 371.7$ #/'



7-5-2 Inertial Force on Neutral Block:

Weight of neutral block (wall + soil + water), from report file
= 38072.52 #/l

Eq inertial force = 38072.52 × 0.2 = 7614.50

Westergaard water force above finished grade
(EM 1110-2-2200, "Gravity Dam Design", 25 Sept 58)

$$C_e = \frac{51}{\sqrt{1 - 0.72\left(\frac{h}{1000\, t_e}\right)^2}}$$ when $t_e = 1$ second

62.0 = water
50.0 = grade
12.0 = h

$$= \frac{51}{\sqrt{1 - 0.72\left(\frac{12.0}{1000}\right)^2}}$$

= 51.0026 #-second units

$$P = \frac{2}{3} C_e \alpha y \sqrt{hy} = \frac{2}{3}(51.0026)(0.2)(12)\sqrt{12 \times 12}$$

= 979.25 #/l

Total inertial force = 7614.50 + 979.25
= 8593.75 #/l

7-5-3 Shear in Stem at Base:

Earth add'l active force = 377 (from model FA)
Westergaard water force = 979
Weight of stem = 6039.876(0.2) = 1208
2564 #/l

7-6 COMPARISONS OF RESULTS

7-6-1 Active Earth Pressures on Stem:

Item	Program	Hand Calculation	Difference	Percent of Hand
Total pressure coefficent	0.8238	0.8207	0.0031	0.38
Additional force on stem, lb/ft	377.45	371.7	5.75	1.55

7-6-2 Inertial Force on Stability Neutral Block:

Program value = 8648.04 lb/ft
Hand calculation = 8593.75

Difference = 54.29 = 0.63 percent of hand-calculated value

7-6-3 Shear in Stem at Base:

Program value = 2618.675 lb/ft
Hand calculation = 2564

Difference = 54.675 = 2.13 percent of hand-calculated value

CHAPTER 8: PROBLEM V7

8-1 DESCRIPTION OF PROBLEM. This problem involves considerations of seepage pressure options for a basic floodwall. The variable IFST in data list SEEP has four possible values:

8-1-1 ISFT=1 (default value) causes the line of creep method to be used as described in EM 1110-2-2501, "Flood Walls."

8-1-2 ISFT=2 causes a perched water table to be used where the full hydrostatic pressure on the end of the heel (or the key if it is under the end of the heel) to be extended across under to the base, with the toe-side pressures to be full hydrostatic down to the top of the toe. An impervious barrier is assumed to extend from the end of the toe outward.

8-1-3 ISFT=3 causes the full hydrostatic pressures to be carried down to the ends of the heel and toe. Uplift is calculated as varying linearly across the base. This is frequently used for retaining walls and dams.

8-1-4 ISFT=4 is like ISFT=3 except that uplift is used as inputted with data list HSPV for analysis, or zero for design.

8-2 PREPARATION OF DATA

8-2-1 Wall Geometry:

List Name	ETS	TW2	STR	HEELW
WLA	120	10	C	18

List Name	BW	BW1	BW2	BS
WLAB	30	29	31	0

List Name	HEELT2	HEELW	HEELT1
WLAH	24"	S	24"

List Name	KFLAG	DKEY	WKEY	BKTE
WLAK	0	4	24"	2

List Name	TSTT	TSB	TSTB	HSTPH	HSTPB	HSBPB
WLAS	24"	0	24"	0	0	0

List Name	BTE1	TOEHT	TS2	TW1	TS1
WLAT	100	24"	100	0	100

8-2-2 Soil Surfaces:

List Name	LC	ESAW	HS3
SSHC	0	106	100

List Name	LC	ESTW	SST
SST	0	106	100

8-2-3 Soil Properties--One Homogeneous Soil:

List Name	PHI3	COH3	GAMAS3	PHIS3	ADHS3	
SPE3	15	650	130	15	650	(terminate list here)

8-2-4 Seepage Data:

Load Case	ISFT	KRACK (1 = yes, 2 = no)	Remarks
1	1	1	
2	2	1	
3	3	1	
4	4	1	Use list HSPV
5	1	2	
6	2	2	
7	3	2	
8	4	2	Use list HSPV

List Name	LC	ELWT	ELWH	HGSW	ISLC	ISFT	KRACK
SEEP	1	106	118	D	1	1	1
SEEP	2	106	118	D	1	2	1
SEEP	3	106	118	D	1	3	1
SEEP	4	106	118	D	1	4	1
SEEP	5	106	118	D	1	1	2
SEEP	6	106	118	D	1	2	2
SEEP	7	106	118	D	1	3	2
SEEP	8	106	118	D	1	4	2

List Name	LC	LOC 1 = End of Toe 31 = End of Heel	PV
HSPV	4	1	625
HSPV	4	31	1125
HSPV	8	1	625
HSPV	8	31	1125

DATA FILE:

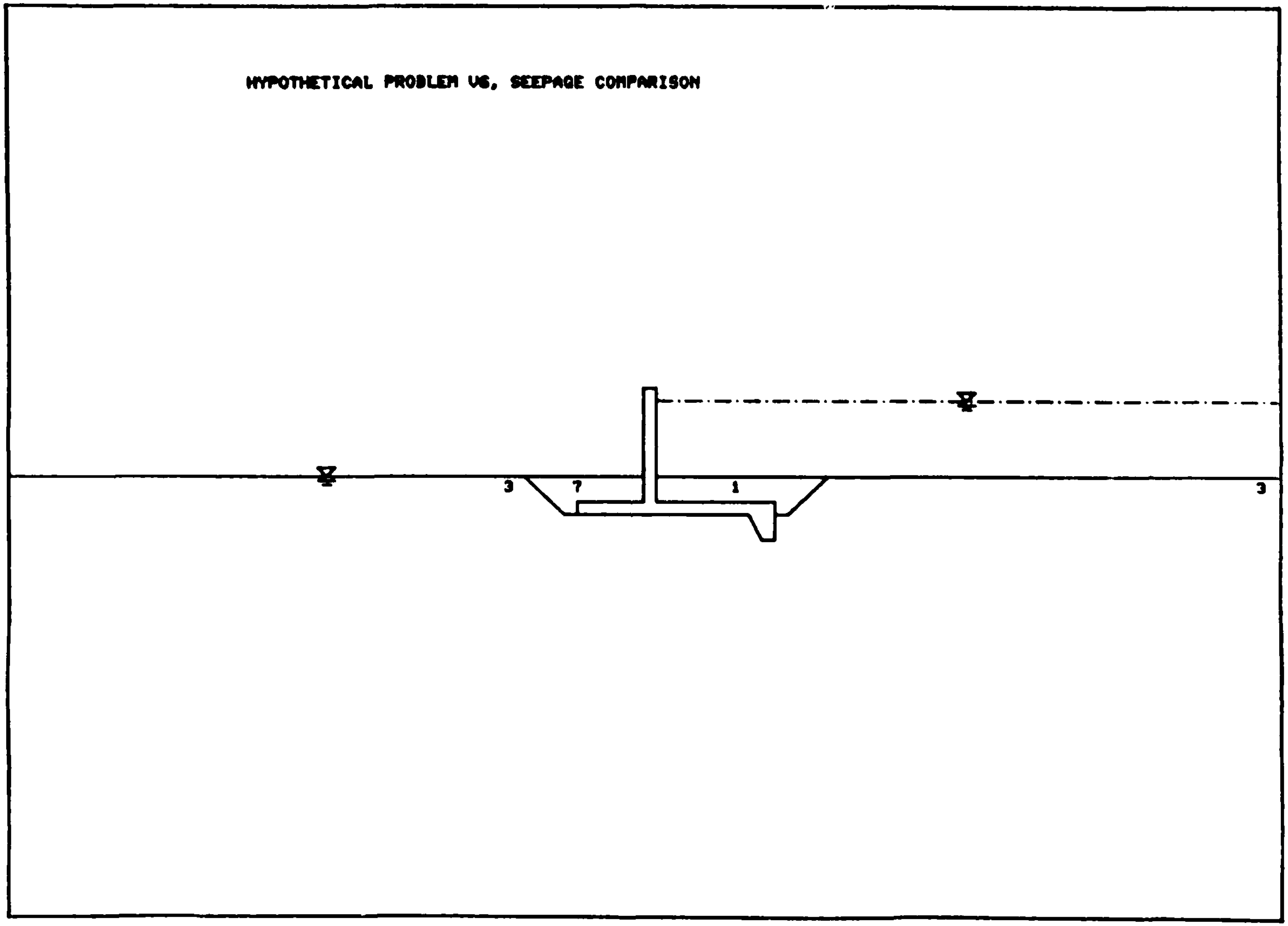
```
LIST EXV7DAT

1000 INIT
1010 8
1020 F
1030 H
1040 NAME  HYPOTHETICAL PROBLEM V7, SEEPAGE COMPARISON
2000 SPE3  15.0  650.0  130.0  15.0  650.0
2100 SSHC  0  106.0  100.0
2110 SST   0  106.0  100.0
3010 SEEP  1  106.0  118.0  D  1  1  1
3020 SEEP  2  106.0  118.0  D  1  2  1
3030 SEEP  3  106.0  118.0  D  1  3  1
3040 SEEP  4  106.0  118.0  D  1  4  1
3050 SEEP  5  106.0  118.0  D  1  1  2
3060 SEEP  6  106.0  118.0  D  1  2  2
3070 SEEP  7  106.0  118.0  D  1  3  2
3080 SEEP  8  106.0  118.0  D  1  4  2
3100 HSPV  4   1   625.0
3110 HSPV  4  31  1125.0
3120 HSPV  8   1   625.0
3130 HSPV  8  31  1125.0
4000 WLA   120.0  10.0  C  18.0
4010 WLAB  30.0  29.0  31.0  0.0
4020 WLAH  24.0  S  24.0
4030 WLAK  0  4.0  24.0  2.0
4040 WLAS  24.0  0.0  24.0  0.0  0.0  C
4050 WLAT  100.0  24.0  100.0  0.0  100.0
5000 UPDATE
```

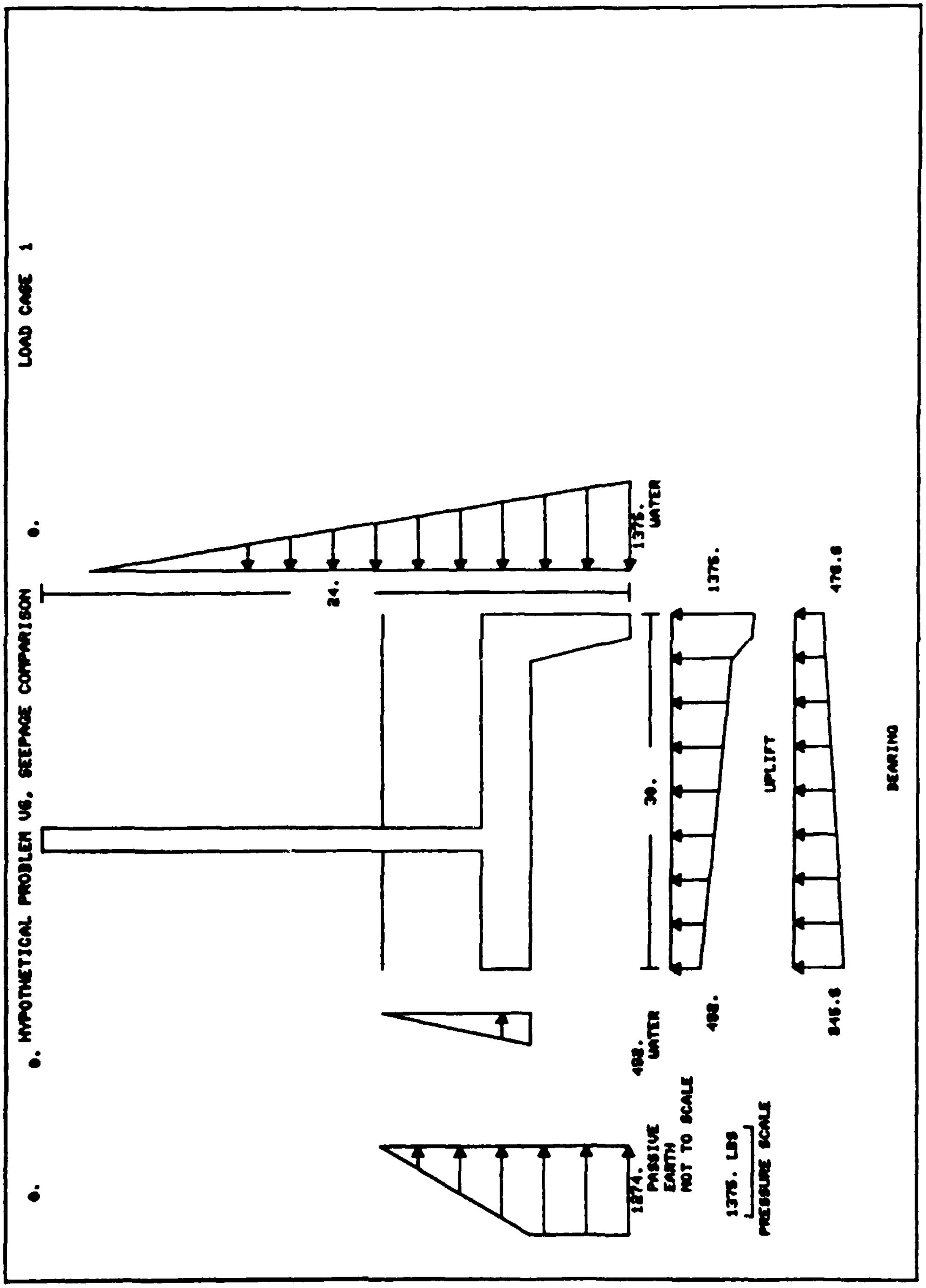
8-3 <u>TIME-SHARING TERMINAL INPUT/OUTPUT AND PART OF REPORT FILE PRINTOUT:</u>

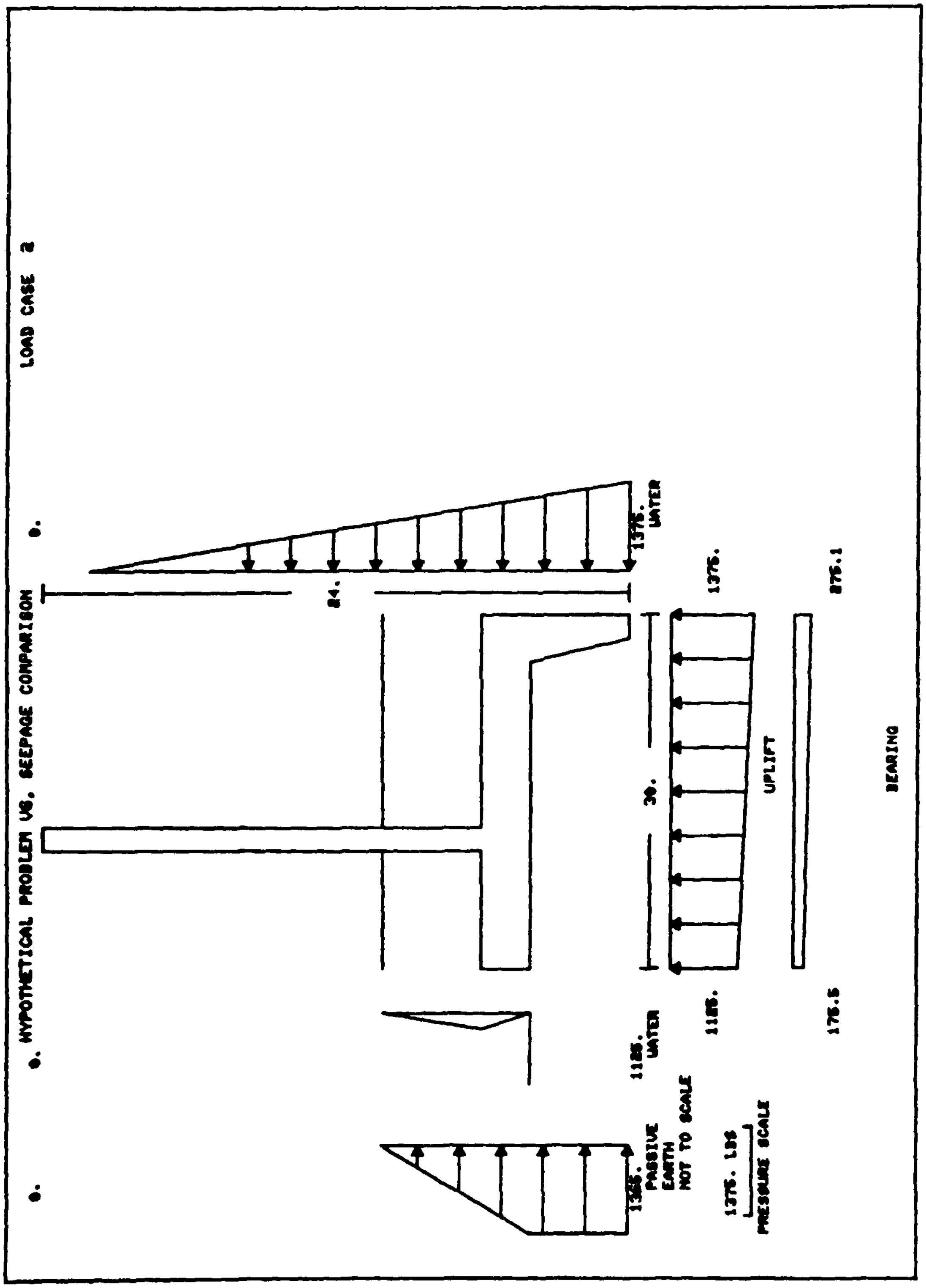
```
*FORTRAN
*RUN WESLIB/TWDA,R

        10/02/80    11.601


PROGRAM TWDA -- 713-F3-R0 087
   T-WALL DESIGN/ANALYSIS
       REL 1.0  AUG 80

(RESPOND WITH ? FOR ANY HELP)

ENTER UPDATE FILE NAME (7 CHAR MAX)
?EXU7UPD


FOR REPORT FILE,
ENTER NAME TO BE USED ON REPORT FILE IDENT CARD, 12 CHAR. MAX.
?W.A.PRICE
ENTER YOUR MACON ACCOUNT NUMBER
?[redacted]

ENTER NAME OF COMMAND-DATA FILE OR
ENTER A CARRIAGE RETURN IF COMMANDS ARE TO BE ENTERED INTERACTIVELY
?EXU7DAT
PROCESSING DATA FILE...

NOT ENOUGH VALUES ENTERED IN DATA LIST - SPE3
TRAILING VALUES SET TO 'C'

$
$ UPDATE FILE RESET
$

$
$ DATA FILE PROCESSING DONE
$
$ RETURN TO INTERACTIVE INPUT
$

COMMAND
?RUN FA

THE RESULTANT RATIO =      0.4535, FOR LOAD CASE  1

THE RESULTANT RATIO =      0.5368, FOR LOAD CASE  2

THE RESULTANT RATIO =      0.4141, FOR LOAD CASE  3

THE RESULTANT RATIO =      0.4832, FOR LOAD CASE  4

THE RESULTANT RATIO =      0.4736, FOR LOAD CASE  5

THE RESULTANT RATIO =      0.5368, FOR LOAD CASE  6

THE RESULTANT RATIO =      0.4141, FOR LOAD CASE  7

THE RESULTANT RATIO =      0.4832, FOR LOAD CASE  8
```

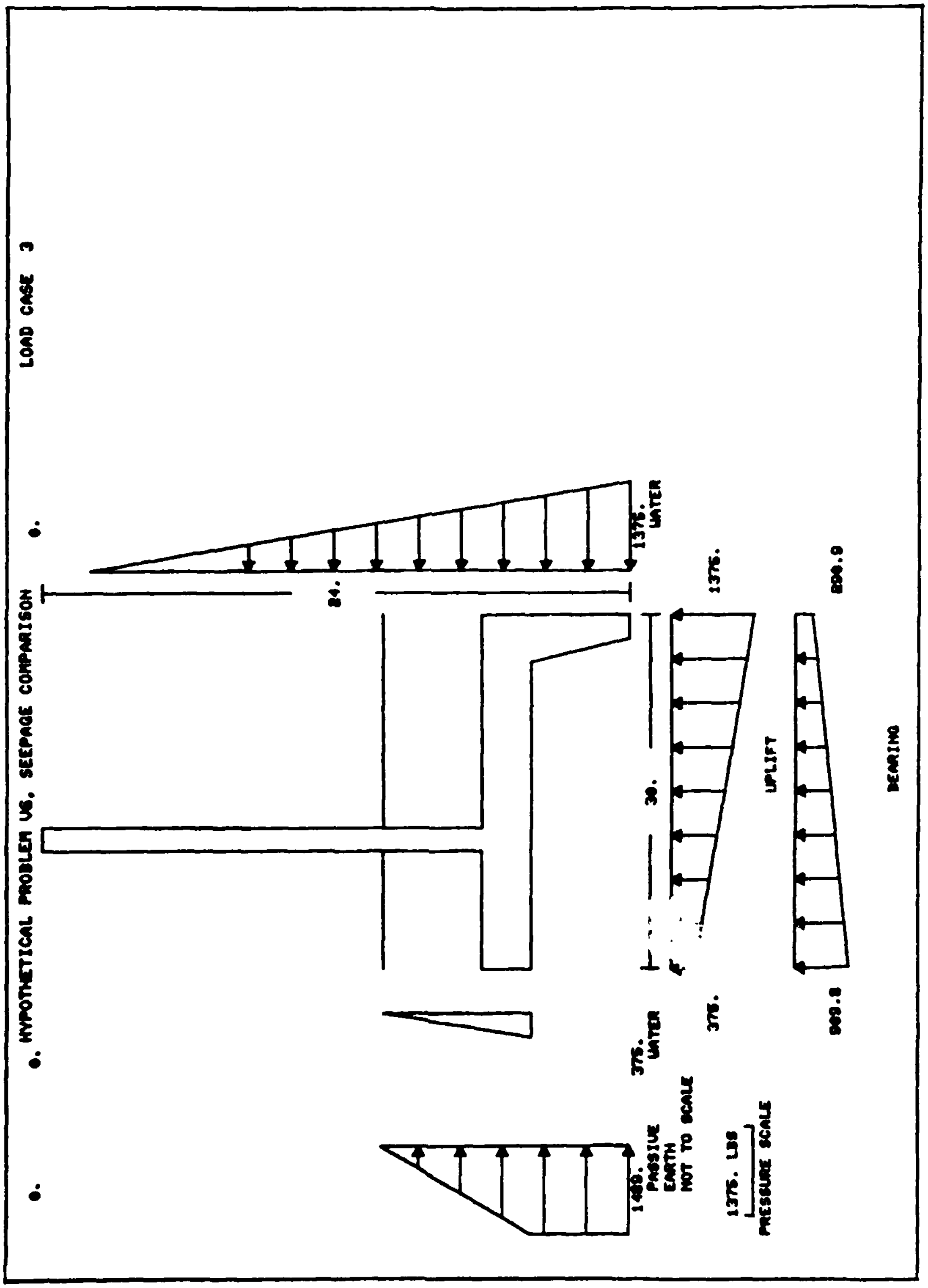
```
FINAL FACTOR OF SAFETY AGAINST SLIDING =     3.90, FOR LOAD CASE  1
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

FINAL FACTOR OF SAFETY AGAINST SLIDING =     3.75, FOR LOAD CASE  2
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

FINAL FACTOR OF SAFETY AGAINST SLIDING =     3.70, FOR LOAD CASE  3
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

FINAL FACTOR OF SAFETY AGAINST SLIDING =     3.45, FOR LOAD CASE  4
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

FINAL FACTOR OF SAFETY AGAINST SLIDING =     3.85, FOR LOAD CASE  5
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

FINAL FACTOR OF SAFETY AGAINST SLIDING =     3.51, FOR LOAD CASE  6
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

FINAL FACTOR OF SAFETY AGAINST SLIDING =     3.49, FOR LOAD CASE  7
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

FINAL FACTOR OF SAFETY AGAINST SLIDING =     3.29, FOR LOAD CASE  8
BY ALLOWABLE STRENGTH METHOD
  C'=C/FS+2C'     TANPHI'=TANPHI/FS

TOTAL CONCRETE VOLUME =        108.00 (CU FT / LF), FOR LOAD CASE  1

TOTAL CONCRETE VOLUME =        108.00 (CU FT / LF), FOR LOAD CASE  2

TOTAL CONCRETE VOLUME =        108.00 (CU FT / LF), FOR LOAD CASE  3

TOTAL CONCRETE VOLUME =        108.00 (CU FT / LF), FOR LOAD CASE  4

TOTAL CONCRETE VOLUME =        108.00 (CU FT / LF), FOR LOAD CASE  5

TOTAL CONCRETE VOLUME =        108.00 (CU FT / LF), FOR LOAD CASE  6

TOTAL CONCRETE VOLUME =        108.00 (CU FT / LF), FOR LOAD CASE  7

TOTAL CONCRETE VOLUME =        108.00 (CU FT / LF), FOR LOAD CASE  8

ENTER 1 TO SEE PLOTS OF THE DATA AND ANALYSES
        (MAKE HARD COPY BEFORE CARRIAGE RETURN)
        (NOTE:  DO NOT ENTER 1 IF YOU ARE GOING TO RUN MODULE WD.)
   OR 0 TO OMIT THE PLOTS
?1
```

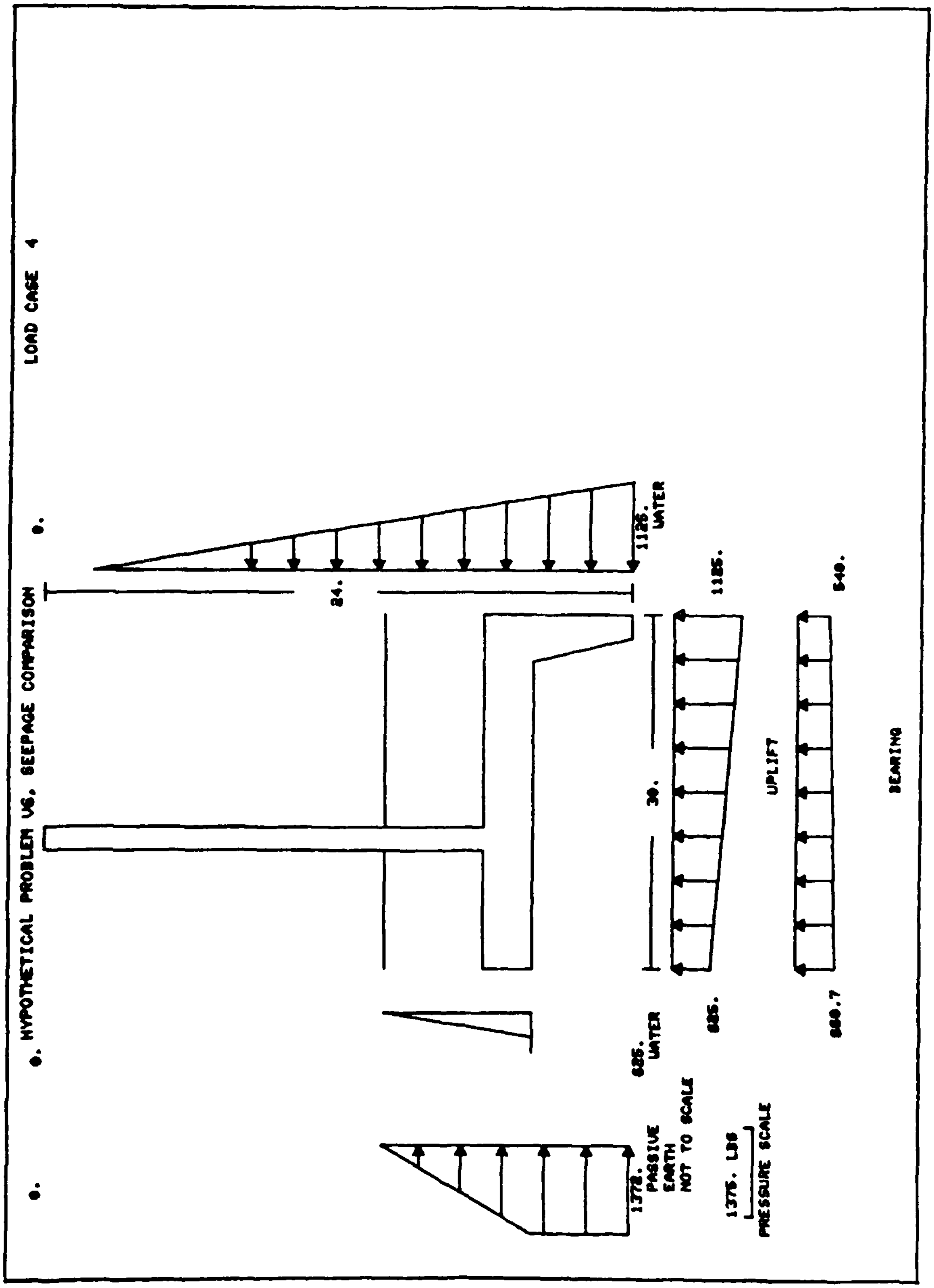
```
NOTE --- A BELL WILL RING AT SELECTED TIMES
         TO ALLOW YOU TO MAKE A HARDCOPY IF
         YOU SO DESIRE. TO RESUME EXECUTION
         SIMPLY ENTER A CARRIAGE RETURN

ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      * TO TERMINATE GRAPHICS
?1
```

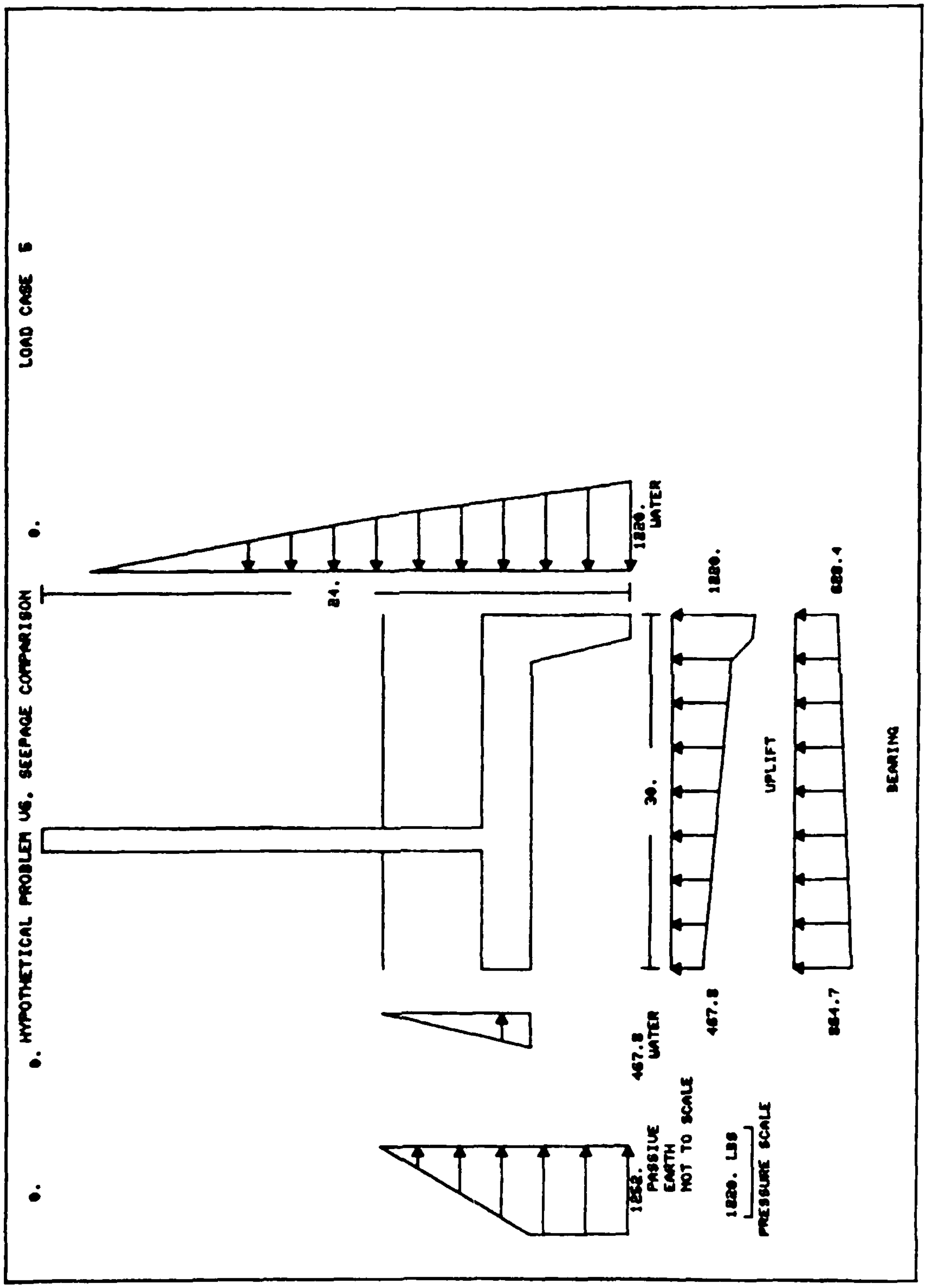

HYPOTHETICAL PROBLEM VS, SEEPAGE COMPARISON
3
7
1
3


HYPOTHETICAL PROBLEM VS. SEEPAGE COMPARISON
LOAD CASE 1
0.
0.
0.
24.
1375.
WATER
30.
1375.
UPLIFT
476.6
BEARING
492.
WATER
492.
845.6
1274.
PASSIVE
EARTH
NOT TO SCALE
1375. LBS
PRESSURE SCALE

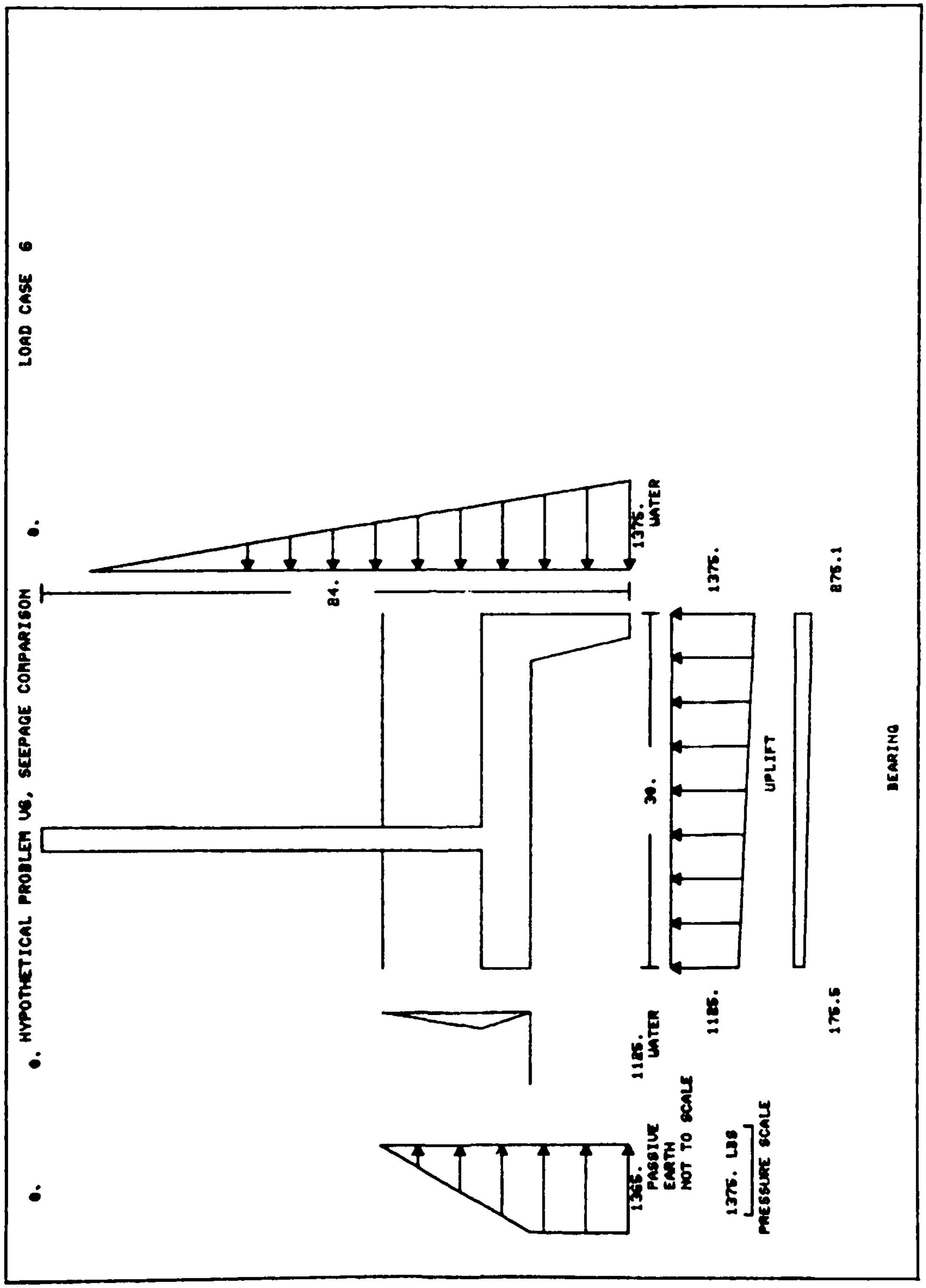

0. HYPOTHETICAL PROBLEM VS. SEEPAGE COMPARISON
LOAD CASE 2
0.
1375.
WATER
84.
1375.
875.1
30.
UPLIFT
BEARING
1185.
WATER
1185.
175.5
0.
1356.
PASSIVE
EARTH
NOT TO SCALE
1375. LBS
PRESSURE SCALE


HYPOTHETICAL PROBLEM VS. SEEPAGE COMPARISON
LOAD CASE 3
0.
0.
0.
1375.
WATER
84.
30.
1375.
UPLIFT
BEARING
375.
WATER
375.
1400.
PASSIVE
EARTH
NOT TO SCALE
1375. LBS
PRESSURE SCALE

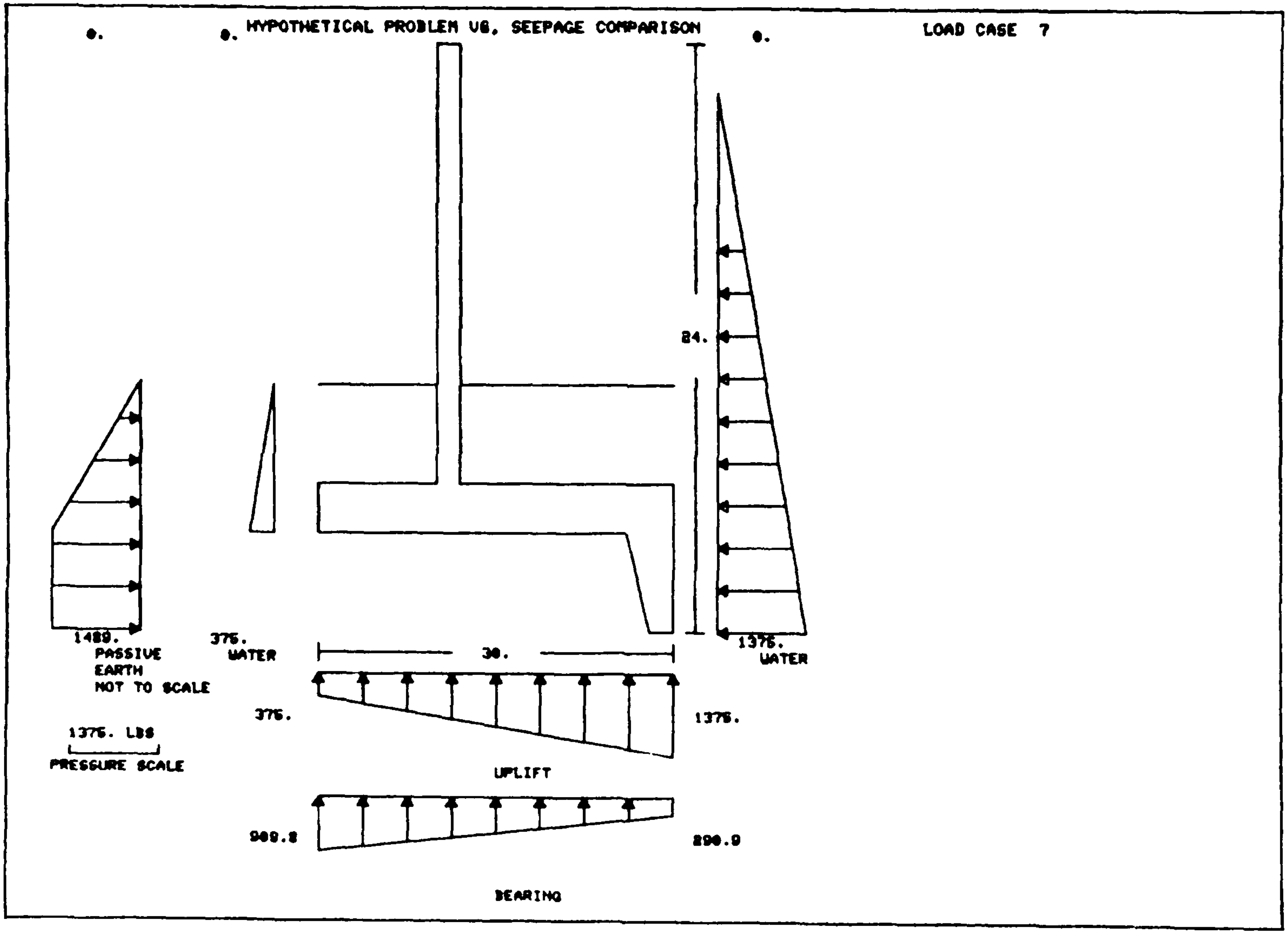

HYPOTHETICAL PROBLEM VS. SEEPAGE COMPARISON
LOAD CASE 4
1126.
WATER
24.
1185.
540.
30.
UPLIFT
BEARING
WATER
PASSIVE
EARTH
NOT TO SCALE
PRESSURE SCALE

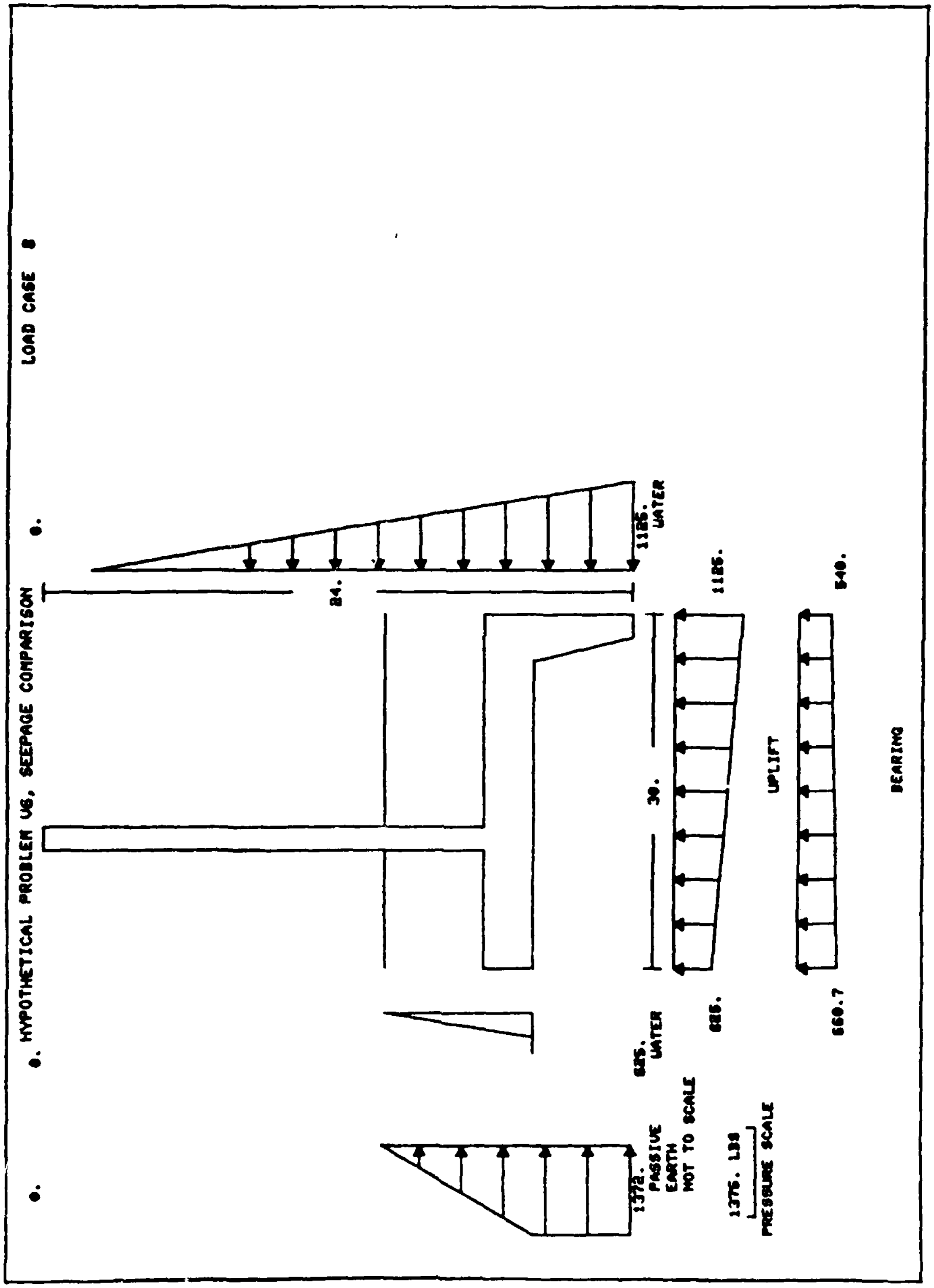


0.
HYPOTHETICAL PROBLEM VS. SEEPAGE COMPARISON
0.
LOAD CASE 5
1820.
WATER
84.
30.
UPLIFT
BEARING
467.8
WATER
467.8
PASSIVE
EARTH
NOT TO SCALE
1820. LBS
PRESSURE SCALE



0. HYPOTHETICAL PROBLEM V6, SEEPAGE COMPARISON
0.
LOAD CASE 6
0.
84.
1375.
WATER
1375.
875.1
30.
UPLIFT
BEARING
1185.
WATER
1185.
175.5
1365.
PASSIVE
EARTH
NOT TO SCALE
1375. LBS
PRESSURE SCALE


0.
0.
HYPOTHETICAL PROBLEM VS. SEEPAGE COMPARISON
0.
LOAD CASE 7
84.
1489.
PASSIVE
EARTH
NOT TO SCALE
375.
WATER
30.
1375.
WATER
375.
1375.
1375. LBS
PRESSURE SCALE
UPLIFT
908.8
290.9
BEARING


0. HYPOTHETICAL PROBLEM VG, SEEPAGE COMPARISON
LOAD CASE 8
0.
0.
0.
84.
1125.
WATER
1125.
540.
30.
UPLIFT
BEARING
825.
WATER
825.
660.7
1372.
PASSIVE
EARTH
NOT TO SCALE
1375. LBS
PRESSURE SCALE

```
ACTIVE LOAD CASES
****** **** *****
                1
                2
                3
                4
                5
                6
                7
                8
ENTER DESIRED ACTIVE LOADCASE
      OR AN * TO RETURN
?*
```

```
ENTER 1 TO PLOT INPUT DATA
      2 TO PLOT FORCES AND MOMENTS
      * TO TERMINATE GRAPHICS
?*
***

*
* UPDATE FILE RESET
*

*
* COMMAND-DATA PHASE ENTERED
*

COMMAND
?END

ENTER 5 TO SEND REPORT TO ADPC TERMINAL
   OR 0 TO SAVE IT AS A PERMANENT FILE
   OR 1 TO DETACH (DESTROY) IT--
?0
ENTER NAME FOR NEW PERMANENT FILE TO HOLD THE REPORT FILE (8 CHAR. MAX.)
?EXV7REPO
REPORT FILE SAVED AS FILE NAMED EXV7REPO (UNLESS <50> MESSAGE PRINTED ABOVE)


your update file for future restart is named EXV7UPD
stop    OK (release unneeded files)
```

```
*EDIT OLD EXV7REPO
-FUS!/OVERTURN/

$ BEGIN THE OVERTURNING COMPUTATION



    LOAD CASE   1


 DEFAULT VALUE OF          1       USED FOR NPPD(LC)   (LOAD CASE  1)
RESULTANT IS WITHIN THE KERN

CREEP PATH DESCRIPTION FOR LOAD CASE 1

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
   20.00              118.00                   0.
   20.00               96.00                1375.00
   18.00               96.00                1336.01
   16.00              100.00                 998.83
  -10.00              100.00                 491.97
  -10.00              106.00                   0.
 OVERTURNING HYDRAULIC GRADIENT  =  0.3119


 > VALUE OF NPPD(LC)   FOUND =          1       IN S/R CHEKIT (LOAD CASE  1)


 PASSIVE EARTH PRESSURES FOR LOAD CASE  1

 NPPD                               =          1
 ELEVATION OF TOP OF SOIL           =    106.10      (FT)
 PRESSURE AT TOP OF SOIL            =   0.           (LBS/SQ.FT)
 ELEVATION AT BOTTOM OF TOE         =    100.00      (FT)
 PRESSURE AT BOTTOM OF TOE          =   -1273.7      (LBS/SQ.FT)
 ELEVATION OF LOWEST POINT ON WALL  =    96.000      (FT)
 PRESSURE AT LOWEST POINT ON WALL   =   -1273.7      (LBS/SQ.FT)
 PASSIVE EARTH FORCE                =   -8979.4      (LBS/SLICE)
 PASSIVE EARTH MOMENT               =   -2290.5      (FT-LBS/SLICE)

 DISTANCE FROM THE TOE TO THE RESULTANT        = 13.60 (FT)
 VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE  =    -24426.20 (LBS/SLICE)
 HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES  =      8979.42 (LBS/SLICE)
 MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES  =  -479536.79 (FT-LBS/SLICE)

THE RESULTANT RATIO =      0.4535, FOR LOAD CASE  1
```

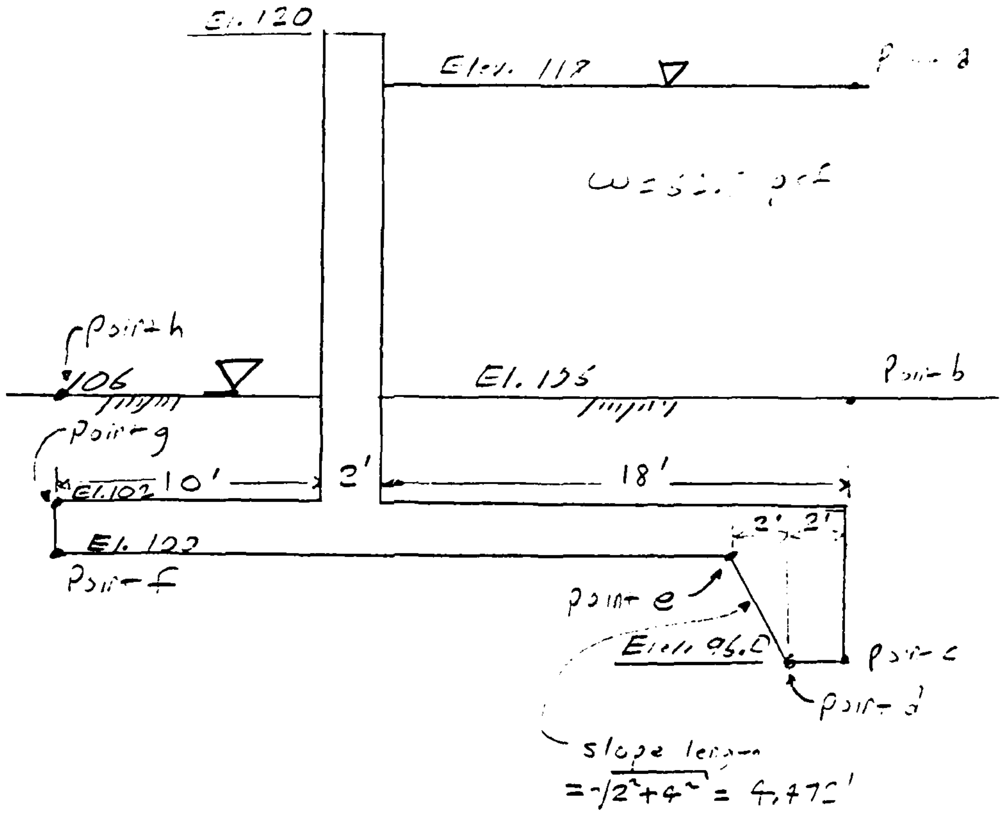
```
    LOAD CASE   2


 DEFAULT VALUE OF          1      USED FOR NPPD(LC)   (LOAD CASE  2)
RESULTANT IS WITHIN THE KERN

 > VALUE OF NPPD(LC)   FOUND =          1      IN S/R CHEKIT (LOAD CASE  2)


 PASSIVE EARTH PRESSURES FOR LOAD CASE  2

 NPPD                                =          1
 ELEVATION OF TOP OF SOIL            =   106.10       (FT)
 PRESSURE AT TOP OF SOIL             =  0.            (LBS/SQ.FT)
 ELEVATION AT BOTTOM OF TOE          =   100.00       (FT)
 PRESSURE AT BOTTOM OF TOE           =  -1365.2       (LBS/SQ.FT)
 ELEVATION OF LOWEST POINT ON WALL   =   96.000       (FT)
 PRESSURE AT LOWEST POINT ON WALL    =  -1365.2       (LBS/SQ.FT)
 PASSIVE EARTH FORCE                 =  -9625.0       (LBS/SLICE)
 PASSIVE EARTH MOMENT                =  -2455.2       (FT-LBS/SLICE)

 DISTANCE FROM THE TOE TO THE RESULTANT          = 16.11 (FT)
 VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE    =    -37500.00 (LBS/SLICE)
 HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES    =      9625.00 (LBS/SLICE)
 MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES   =   -640333.34 (FT-LBS/SLICE)

THE RESULTANT RATIO =      0.5368, FOR LOAD CASE  2


    LOAD CASE   3


 DEFAULT VALUE OF          1      USED FOR NPPD(LC)   (LOAD CASE  3)
RESULTANT IS WITHIN THE KERN

 > VALUE OF NPPD(LC)   FOUND =          1      IN S/R CHEKIT (LOAD CASE  3)


 PASSIVE EARTH PRESSURES FOR LOAD CASE  3

 NPPD                                =          1
 ELEVATION OF TOP OF SOIL            =   106.10       (FT)
 PRESSURE AT TOP OF SOIL             =  0.            (LBS/SQ.FT)
 ELEVATION AT BOTTOM OF TOE          =   100.00       (FT)
 PRESSURE AT BOTTOM OF TOE           =  -1489.4       (LBS/SQ.FT)
 ELEVATION OF LOWEST POINT ON WALL   =   96.000       (FT)
 PRESSURE AT LOWEST POINT ON WALL    =  -1489.4       (LBS/SQ.FT)
 PASSIVE EARTH FORCE                 =  -10500.       (LBS/SLICE)
 PASSIVE EARTH MOMENT                =  -2678.4       (FT-LBS/SLICE)

 DISTANCE FROM THE TOE TO THE RESULTANT          = 12.42 (FT)
 VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE    =    -26250.00 (LBS/SLICE)
 HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES    =     10500.00 (LBS/SLICE)
 MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES   =   -525250.00 (FT-LBS/SLICE)

THE RESULTANT RATIO =      0.4141, FOR LOAD CASE  3
```

```
    LOAD CASE   4


 DEFAULT VALUE OF          1      USED FOR NPPD(LC)   (LOAD CASE  4)
RESULTANT IS WITHIN THE KERN
 > ENTER S/R PRSDAT
 > VALUE OF NPPD(LC)   FOUND =          1      IN S/R CHEKIT (LOAD CASE  4)


 PASSIVE EARTH PRESSURES FOR LOAD CASE  4

 NPPD                                 =         1
 ELEVATION OF TOP OF SOIL             =   106.10      (FT)
 PRESSURE AT TOP OF SOIL              =  0.           (LBS/SQ.FT)
 ELEVATION AT BOTTOM OF TOE           =   100.00      (FT)
 PRESSURE AT BOTTOM OF TOE            =  -1378.3      (LBS/SQ.FT)
 ELEVATION OF LOWEST POINT ON WALL    =   96.000      (FT)
 PRESSURE AT LOWEST POINT ON WALL     =  -1378.3      (LBS/SQ.FT)
 PASSIVE EARTH FORCE                  =  -9675.0      (LBS/SLICE)
 PASSIVE EARTH MOMENT                 =  -2467.9      (FT-LBS/SLICE)

 DISTANCE FROM THE TOE TO THE RESULTANT          = 14.50 (FT)
 VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE   =    -26250.00 (LBS/SLICE)
 HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES   =      9675.00 (LBS/SLICE)
 MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES  =  -480098.62 (FT-LBS/SLICE)

THE RESULTANT RATIO =      0.4832, FOR LOAD CASE  4


    LOAD CASE   5


 DEFAULT VALUE OF          1      USED FOR NPPD(LC)   (LOAD CASE  5)
RESULTANT IS WITHIN THE KERN

CREEP PATH DESCRIPTION FOR LOAD CASE 5

X-COORDINATES      Y-COORDINATES      HYDROSTATIC PRESSURE
   20.00              118.00                   0.
   20.00              106.00                 750.00
   20.00              100.00                1032.16
   20.00               96.00                1220.27
   18.00               96.00                1189.33
   16.00              100.00                 870.13
  -10.00              100.00                 467.84
  -10.00              106.00                   0.
 OVERTURNING HYDRAULIC GRADIENT  =  0.2476

 > VALUE OF NPPD(LC)   FOUND =          1      IN S/R CHEKIT (LOAD CASE  5)


 PASSIVE EARTH PRESSURES FOR LOAD CASE  5
```

```
NPPD                                     =        1
ELEVATION OF TOP OF SOIL                 =   106.10     (FT)
PRESSURE AT TOP OF SOIL                  =  0.          (LBS/SQ.FT)
ELEVATION AT BOTTOM OF TOE               =   100.00     (FT)
PRESSURE AT BOTTOM OF TOE                =  -1852.3     (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL        =   96.000     (FT)
PRESSURE AT LOWEST POINT ON WALL         =  -1852.3     (LBS/SQ.FT)
PASSIVE EARTH FORCE                      =  -8828.9     (LBS/SLICE)
PASSIVE EARTH MOMENT                     =  -2252.1     (FT-LBS/SLICE)

DISTANCE FROM THE TOE TO THE RESULTANT          = 14.21 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE   =    -81862.62 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES   =      8828.94 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES  =   -431168.08 (FT-LBS/SLICE)

THE RESULTANT RATIO =      0.4736, FOR LOAD CASE  5



    LOAD CASE   6



 DEFAULT VALUE OF          1       USED FOR NPPD(LC)   (LOAD CASE  6)

RESULTANT IS WITHIN THE KERN

 > VALUE OF NPPD(LC)   FOUND =          1       IN S/R CHEKIT (LOAD CASE  6)



 PASSIVE EARTH PRESSURES FOR LOAD CASE  6

 NPPD                                     =        1
 ELEVATION OF TOP OF SOIL                 =   106.10     (FT)
 PRESSURE AT TOP OF SOIL                  =  0.          (LBS/SQ.FT)
 ELEVATION AT BOTTOM OF TOE               =   100.00     (FT)
 PRESSURE AT BOTTOM OF TOE                =  -1365.2     (LBS/SQ.FT)
 ELEVATION OF LOWEST POINT ON WALL        =   96.000     (FT)
 PRESSURE AT LOWEST POINT ON WALL         =  -1365.2     (LBS/SQ.FT)
 PASSIVE EARTH FORCE                      =  -9625.0     (LBS/SLICE)
 PASSIVE EARTH MOMENT                     =  -2455.2     (FT-LBS/SLICE)

 DISTANCE FROM THE TOE TO THE RESULTANT          = 16.11 (FT)
 VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE   =    -37500.00 (LBS/SLICE)
 HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES   =      9625.00 (LBS/SLICE)
 MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES  =   -640333.34 (FT-LBS/SLICE)

THE RESULTANT RATIO =      0.5368, FOR LOAD CASE  6



    LOAD CASE   7



 DEFAULT VALUE OF          1       USED FOR NPPD(LC)   (LOAD CASE  7)

RESULTANT IS WITHIN THE KERN

 > VALUE OF NPPD(LC)   FOUND =          1       IN S/R CHEKIT (LOAD CASE  7)
```

```
PASSIVE EARTH PRESSURES FOR LOAD CASE  7

NPPD                              =          1
ELEVATION OF TOP OF SOIL          =   106.10      (FT)
PRESSURE AT TOP OF SOIL           =  0.           (LBS/SQ.FT)
ELEVATION AT BOTTOM OF TOE        =   100.00      (FT)
PRESSURE AT BOTTOM OF TOE         =  -1489.4      (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL =   96.000      (FT)
PRESSURE AT LOWEST POINT ON WALL  =  -1489.4      (LBS/SQ.FT)
PASSIVE EARTH FORCE               =  -10500.      (LBS/SLICE)
PASSIVE EARTH MOMENT              =  -2678.4      (FT-LBS/SLICE)

DISTANCE FROM THE TOE TO THE RESULTANT          = 12.42 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE   =    -26250.00 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES   =     10500.00 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES  =   -525250.00 (FT-LBS/SLICE)

THE RESULTANT RATIO =      0.4141, FOR LOAD CASE  7



     LOAD CASE   8



 DEFAULT VALUE OF          1      USED FOR NPPD(LC)   (LOAD CASE  8)

RESULTANT IS WITHIN THE KERN


 > ENTER S/R PRSDAT

 > VALUE OF NPPD(LC)   FOUND =          1      IN S/R CHEKIT (LOAD CASE  8)


PASSIVE EARTH PRESSURES FOR LOAD CASE  8

NPPD                              =          1
ELEVATION OF TOP OF SOIL          =   106.10      (FT)
PRESSURE AT TOP OF SOIL           =  0.           (LBS/SQ.FT)
ELEVATION AT BOTTOM OF TOE        =   100.00      (FT)
PRESSURE AT BOTTOM OF TOE         =  -1378.3      (LBS/SQ.FT)
ELEVATION OF LOWEST POINT ON WALL =   96.000      (FT)
PRESSURE AT LOWEST POINT ON WALL  =  -1372.3      (LBS/SQ.FT)
PASSIVE EARTH FORCE               =  -9675.0      (LBS/SLICE)
PASSIVE EARTH MOMENT              =  -2467.9      (FT-LBS/SLICE)

DISTANCE FROM THE TOE TO THE RESULTANT          = 14.50 (FT)
VERTICAL FORCE DUE TO UPLIFT PRESSURE ON BASE   =    -26250.00 (LBS/SLICE)
HORIZONTAL FORCE DUE TO HYDROSTATIC PRESSURES   =      9675.00 (LBS/SLICE)
MOMENT DUE TO UPLIFT AND HYDROSTATIC PRESSURES  =   -488098.62 (FT-LBS/SLICE)

THE RESULTANT RATIO =      0.4832, FOR LOAD CASE  8
```

8-4 HAND CALCULATIONS:



8-4-1 Line of Creep for Load Case 1 (Crack). Creep path length = 2.00 + 4.472 + 26.00 + 6.00 = 38.472 ft:

Point	Y Coordinate	Position Head	Potential Head	Pressure
a	118.00	-12	12	0
b	106.00	0	12	750
c	96.00	10	12	1375
d	96.00	10	11.376	1336
e	100.00	6	9.981	999
f	100.00	6	1.871	492
h	106.00	0	0	0

8-4-2 Perched Water Table for Load Case 2:

Point	Pressure, psf	Direction
a	0	←
c	62.5(118 - 96) = 1375	←
c	1375	↑
f	62.5(118 - 100) = 1125	↑
c	1375	→
f	1125	→
g	62.5(106 - 102) = 250	→
h	0	→

$$\text{Horizontal force} = 1375(22)\frac{1}{2} - \frac{1375 + 1125}{2}(4) - 250(4)\frac{1}{2} = 9625 \text{ lb/ft}$$

$$\text{Vertical force} = \frac{(1375 + 1125)}{2}(30) = 37{,}500 \text{ lb/ft}$$

8-4-3 Load Case 3--Full Hydrostatic:

Point	Pressure, psf	Direction
a	0	←
c	62.5(118 - 96) = 1375	←
c	1375	↑
f	62.5(106 - 100) = 375	↑
d	1375	→
f	375	→
f	375	→
h	0	→

$$\text{Horizontal force} = 1375(22)\frac{1}{2} - 375(6)\frac{1}{2} - \frac{1375 + 375}{2}(4) = 10{,}500 \text{ lb/ft} \leftarrow$$

$$\text{Vertical force} = \frac{1375 + 375}{2}(30) = 26{,}250 \text{ lb/ft} \uparrow$$

8-4-4 Load Case 4--Load Case 3 with Special Input Uplift:

Point	Pressure, psf	Direction
a	0	←
c	1375	←
c	1125 (data list HSPV at LOC = 31)	↑
f	625 (data list HSPV at LOC = 1)	↑
d	proportion = $625 + \frac{1125 - 625}{1}(\frac{28}{30}) = 1092$	→
f	proportion = $625 + \frac{1125 - 625}{1}(\frac{26}{30}) = 1058$	→
f	62.5(106 - 100) = 375	→
h	0	→

$$\text{Horizontal force} = 1375(22)\frac{1}{2} - \frac{1092 + 1058}{2}(4) - 375(6)\frac{1}{2} = 9700 \text{ lb/ft}$$

$$\text{Vertical force} = \frac{1125 + 625}{2}(30) = 26{,}250 \text{ lb/ft}$$

8-4-5 Line of Creep for Load Case 5 (No Crack). Creep path length = 10.00 + 38.472 = 48.472 ft:

Point	Y Coordinate	Position Head	Potential Head	Pressure
a	118.00	-12	12	0
b	106.00	0	12	750
c	96.00	10	9.524	1220.25
d	96.00	10	9.0292	1189.325
e	100.00	6	7.992	870.125
f	100.00	6	1.4654	466.5875
h	106.00	0	0	0

8-4-6 Load Cases 6, 7, and 8. These should be the same as Load Cases 2, 3, and 4.

8-5 COMPARISONS OF RESULTS

8-5-1 Load Case 1--Line of Creep, with Crack:

X Coordinate	Y Coordinate	Program	Hand Calculation	Difference
20.00	118.00	0.0	0.0	0
20.00	96.00	1375	1375	0
18.00	96.00	1336	1336	0
16.00	100.00	999	999	0
-10.00	100.00	492	492	0
-10.00	106.00	0.0	0.0	0

8-5-2 Load Case 2--Perched Water Table:

Value	Program	Hand Calculation	Difference
Horizontal force, lb/ft	9,625	9,625	0
Vertical force, lb/ft	-37,500	-37,500	0

8-5-3 Load Case 3--Full Hydrostatic:

Value	Program	Hand Calculation	Difference
Horizontal force, lb/ft	10,500	10,500	0
Vertical force, lb/ft	-26,250	-26,250	0

8-5-4 Load Case 4--Load Case 3 with Special Input Uplift:

Value	Program	Hand Calculation	Difference
Horizontal force, lb/ft	9,675	9,700	25 = 0.26%
Vertical force, lb/ft	-26,250	-26,250	0

8-5-5 Load Case 5--Line of Creep, No Crack:

X Coordinate	Y Coordinate	Program	Hand Calculation	Difference
20.00	118.00	0	0	0
20.00	106.00	750.00	750.00	0
20.00	100.00	1032.16	--	--
20.00	96.00	1220.27	1220.25	0
18.00	96.00	1189.33	1189.33	0
16.00	100.00	870.13	870.125	0
-10.00	100.00	467.84	466.5875	1.2525 = 0.3%
-10.00	106.00	0	0	0

8-5-6 Load Cases 6-8. With full hydrostatic pressure calculated down to the bottom of the heel, the existence of a crack in the heel earth cover should make no difference:

Load Case	Program Output Horizontal Force	Vertical Force	Difference
2	9,625.00	-37,500.00	0
6	9,635.00	-37,500.00	0
3	10,500.00	-26,250.00	0
7	10,500.00	-26,500.00	0
4	9,675.00	-26,250.00	0
8	9,675.00	-26,250.00	0

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Validation report : computer program for design and analysis of inverted-T retaining walls and floodwalls (TWDA) : final report / by William A. Price ... [et al.] (Automatic Data Processing Center, U.S. Army Engineer Waterways Experiment Station) ; prepared for Office, Chief of Engineers, U.S. Army and U.S. Army Engineer Division, Lower Mississippi Valley. -- Vicksburg, Miss. : U.S. Army Engineer Waterways Experiment Station ; Springfield, Va. : available from NTIS, 1981.

vi, [illegible] p. : ill. ; 27 cm. -- (Instruction report / U.S. Army Engineer Waterways Experiment Station ; K-81-3)

Cover title.

"February 1981."

"A report under the Computer-Aided Structural Engineering (CASE) Project."

1. Computer-Aided Structural Engineering (CASE) Project. 2. Programming (Electronic Computers). 3. Retaining walls. 4. Flood control. 5. TWDA (Computer program).

Validation report: computer program for design and analysis of inverted-T retaining walls and floodwalls (TWDA) : ...

(Card 2)

I. Price, William A. II. United States. Army. Corps of Engineers. Office of the Chief of Engineers. III. United States. Army. Corps of Engineers. Lower Mississippi Valley Division. IV. United States. Army Engineer Waterways Experiment Station. Automatic Data Processing Center. V. Title VI. Series: Instruction report (United States. Army Engineer Waterways Experiment Station) ; K-81-3.

TA7.W34i no.K-81-3

WATERWAYS EXPERIMENT STATION REPORTS PUBLISHED UNDER THE COMPUTER-AIDED STRUCTURAL ENGINEERING (CASE) PROJECT

	Title	Date
Technical Report K-78-1	List of Computer Programs for Computer-Aided Structural Engineering	Feb 1978
Instruction Report O-79-2	User's Guide: Computer Program with Interactive Graphics for Analysis of Plane Frame Structures (CFRAME)	Mar 1979
Technical Report K-80-1	Survey of Bridge-Oriented Design Software	Jan 1980
Technical Report K-80-2	Evaluation of Computer Programs for the Design/Analysis of Highway and Railway Bridges	Jan 1980
Instruction Report K-80-1	User's Guide: Computer Program for Design/Review of Curvilinear Conduits/Culverts (CURCON)	Feb 1980
Instruction Report K-80-3	A Three-Dimensional Finite Element Data Edit Program	Mar 1980
Instruction Report K-80-4	A Three-Dimensional Stability Analysis/Design Program (3DSAD)	
	Report 1: General Geometry Module	Jun 1980
Instruction Report K-80-6	Basic User's Guide: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Dec 1980
Instruction Report K-80-7	User's Reference Manual: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Dec 1980
Technical Report K-80-4	Documentation of Finite Element Analyses	
	Report 1: Longview Outlet Works Conduit	Dec 1980
	Report 2: Anchored Wall Monolith, Bay Springs Lock	Dec 1980
Technical Report K-80-5	Basic Pile Group Behavior	Dec 1980
Instruction Report K-81-2	User's Guide: Computer Program for Design and Analysis of Sheet Pile Walls by Classical Methods (CSHTWAL)	
	Report 1: Computational Processes	Feb 1981
	Report 2: Interactive Graphics Options	Mar 1981
Instruction Report K-81-3	Validation Report: Computer Program for Design and Analysis of Inverted-T Retaining Walls and Floodwalls (TWDA)	Feb 1981
Instruction Report K-81-4	User's Guide: Computer Program for Design and Analysis of Cast-in-Place Tunnel Linings (NEWTUN)	Mar 1981
Instruction Report K-81-6	User's Guide: Computer Program for Optimum Nonlinear Dynamic Design of Reinforced Concrete Slabs Under Blast Loading (CBARCS)	Mar 1981
Instruction Report K-81-7	User's Guide: Computer Program for Design or Investigation of Orthogonal Culverts (CORTCUL)	Mar 1981